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DEFENSE SCIENCE BOARD

REPORT OF THE TASK FORCE ON TRAINING TECHNOLOGY

15 MARCH 1976

Office of the Director of Defense Research and Engineering - Washington, D. C.

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CHAPTER 1

INTRODUCTION

On 3 June 1974, the Director of Defense Research and Engineering, Malcolm R. Currie, requested that a Defense Science Board Task Force on Training Technology be formed to evaluate the effectiveness of DoD programs and management of R&D on training technology. The purpose of the evaluation was to provide technical, management and operational guidance in reducing costs and increasing effectiveness of DoD training.

The request for creation of the Task Force was initiated primarily in hopes of finding ways to reduce the costs of DoD education and training which were estimated to be in excess of $7 billion per year. Increases in Defense manpower costs over the last decade, from $23.9 billion (47 per cent of the total Defense budget) in Fiscal Year 1964 to $52.5 billion (57 per cent) in Fiscal Year 1975 were caused primarily by pay increases designed to achieve and maintain comparability with civilian sector wages. The increase in manpower costs along with economic pressures to reduce the total Defense budget stimulated this attention to the possibility of reducing these costs through application of advances in technology to the services' training systems.

Indeed, a substantial part of Defense manpower costs are related to the formal training requirements of the services; at any given time during the past five years, between 15 and 20 per cent of all military personnel were either giving training or being trained themselves. Each year nearly two million servicemen and women receive training in one of over 2,000 specialities. Of course, the size of the useful military forces is lower than it would be if these persons were not involved in training, but were in mission-related defense activities. Likewise, operational readiness is reduced by the use of operational equipment for training purposes. For example, in 1972, the value of operational equipment used for training was estimated to be $4.5 billion, while the inventory of training devices and aids was estimated to be $1.2 billion. It is possible that increased use of training aids and devices could increase training effectiveness, while releasing operational equipment from training use, thereby reducing also the high costs of maintaining and repairing operational equipment that has a higher wear and damage likelihood when used by untrained personnel.

The service training system, largely labor intensive and group paced, was seen to lack the flexibility needed to deal effectively with surge or drawdown training requirements. Advances in training technology, the systems-engineering approach to training, self-paced or individualized instruction, and the use of computers in training suggested that application of such training methods and media capability could significantly increase the flexibility and effectiveness of DoD training and reduce training costs as well. Thus, it appears that if ways could be found to develop and apply the training-technology capability, the manpower costs related to training could be reduced significantly.

The objective of the DSB Task Force on Training Technology was to determine the effectiveness of existing DoD R&D programs and management in the area of training technology and if indicated, recommend alternative management appreaches as well as changes in areas of program emphasis and funding. In this comprehensive evaluation, the Task Force was to examine work in training systems, methods, procedures, media and software, as well as training equipment, devices, aids, and simulators. There were several key issues to be addressed:

1. How successfully did the Training Technology R&D programs address critical education and training problems?

2. Were there needless overlaps and duplications in programs or facilities or major gaps within programs?

3. Did the R&D management structure provide for an integrated program across DoD?

4. Could alternate management approaches reduce costs, expedite application of R&D results and provide adequate flexibility of response to training technology requirements?

To define the scope of the effort, the DSB Task Force was requested to perform the following:

1. Evaluate the effectiveness of procedures used to establish training R&D requirements and priorities within OSD and the Military Departments.

2. Evaluate the Training Technology R&D management structure to determine if an integrated program existed across DoD which was adressing critical DoD training technology needs.

3. Determine if alternative management approaches could reduce costs, expedite the application of R&D results and provide the flexibility of response to individual military department needs. Opportunities to consolidate R&D programs and/or facilities, were to be given consideration. The Task Force was to include explicit assessments of the extent to which there should be developed within specific Training Technology R&D areas: a common Training Technology R&D program for all Military Departments; lead service programs in terms of initiative and leadership with downstream modification and application to other services; and/or separate service programs with emphasis on coordination of major thrusts.

4. Evaluate the procedures used by program managers to develop and procure training materials for operations and maintenance of major weapon systems (including training devices and simulators, job guides, mock-ups and other training media). Considering training effectiveness

and cost factors, evaluate and recommend where low cost training equipment could be substituted for expensive components and subsystems being used for training.

5. Evaluate, in relation to operations and maintenance problems the R&D management procedures for prototype lesson and software development for both technical school and on-the-job training.

6. Recommend alternative management approaches for each area of evaluation if indicated.

The Defense Science Board Task Force on Training Technology consisted of the following members:

Dr. Earl A. Alluisi, Chairman
University Professor of Psychology
Old Dominion University

Dr. O. S. Adams
Manager, Advanced Design Division
Lockheed-Georgia Company

Dr. David B. Bobrow
Professor and Chairman
Department of Government and Politics
University of Maryland

Professor Ralph Flexman
Director, Institute of Aviation
University of Illinois

Dr. C. B. Gambrell, Jr.
Vice President for Academic Affairs
Florida Technological University

Dr. Howard H. McFann
Director, Western Division
Human Resources Research Organization

Dr. Jesse Orlansky
Assistant Director
Science and Technology Division
Institute for Defense Analyses

Dr. Joseph Rigney
Director, Behavioral Technology Laboratories
University of Southern California

Dr. H. Wallace Sinaiko
Program Director
Manpower Research and Advisory Services
Smithsonian Institution

Lt. Col. Henry L. Taylor, USAF
Executive Secretary
Military Assistant for Human Resources
ODDR&E, Department of Defense

Dr. Thomas C. Rowan, Consultant
Rowan and Associates

Mr. Richard J. Bryan, Research Assistant
Rowan and Associates

CHAPTER 2

METHODOLOGY

2.1 LIASON WITH SERVICE AND OTHER DOD OFFICES

Representatives of each service and related Defense organizations were appointed to act as liaison between the Task Force and the Military Departments and other OSD offices and agencies. These representatives had the responsibility of ensuring that the Task Force promptly received all requested data and that appropriate and knowledgeable individuals appeared at Task Force Meetings. The representatives were:

Mr. Jacob L. Barber
Research Psychologist
Office of the Assistant Secretary of the Army (R&D)

Captain H. J. Connery, USN
Assistant for Human Factors, Plans
Office of the Assistant Secretary of the Navy (R&D)

Lt. Col. Laverne G. Junkman, USAF
Operations Research Analyst
Office of the Assistant Secretary of Defense (M&RA)

Colonel Austin W. Kibler, USAF
Director, Human Resources Research Office
Advanced Research Projects Agency

Lt. Col. Robert E. Wilkinson, USAF
Staff Officer, Personnel and Training Technology
Office of the Assistant Secretary of the Air Force (R&D)

2.2 SCHEDULE OF MEETINGS

In the early stages of formation of the Task Force, it was decided that the most effective method of examining Training Technology R&D was for one Task Force member to act as chapter lead and concentrate on one of the functional areas of training. Utilization of functional training areas was necessary to ensure consistency with the Military Manpower Training Report (MMTR) and with the categorization used by the training community. Two areas, Crew/Group/Team/Unit (CGTU) Training and Weapon Systems Training Sub-system Development were added to the MMTR categorization to complete the Task Force's Examination of Training Technology R&D.

The chapter lead, assisted by the full Task Force and staff, had complete responsibility for the development of his chapter, from the initial stage of collection of data to the preparation of the final draft. Table 2-1 provides a list of the meetings by functional training areas, with the name of chapter leads in parentheses.

TABLE 2-1

SCHEDULE OF MEETINGS OF DEFENSE SCIENCE BOARD
TASK FORCE ON TRAINING TECHNOLOGY

Date	Topic
23 July 1974	Organizational Meeting
17-18 Sept 1974	Flight Training Technology (Flexman)
15-16 Oct 1974	Weapons Systems Training Subsystems Development and Technology (Adams)
25-26 Nov 1974	Recruit or Basic Individual Training Technology (McFann)
16-18 Dec 1974	Individual Specialized Skill Training Technology (Orlansky)
21-22 Jan 1975	Crew/Group/Team/Unit Special Skill Training Technology (Rigney)
18-19 Feb 1975	Officer Acquisition Training and Professional Development Education (Sinaiko)
17-19 Mar 1975	Review of Preliminary Draft of Final Report
20-21 May 1975	Revision and Preparation of Final Draft

The six functional training areas, as presented in the Military Manpower Training Report for FY 1976, are briefly defined below. Each chapter will more fully describe the training areas.

Recruit Training includes the basic introductory physical conditioning, military, and indoctrination training given to all new enlisted entrants in each of the services.

Specialized Skill Training provides officers and enlisted personnel with new or higher levels of knowledge and skills in military specialities to match job requirements. Included in this category are such training programs as Army Advanced Individual Training and Navy Apprenticeship Training.

Officer Acquisition Training includes all types of education and training leading to a commission in one of the services, such as the programs of the Service Academies and officer candidate schools. Professional Development Education includes educational courses conducted at the higher-level service schools or at civilian institutions to

broaden the outlook and knowledge of senior military personnel or to impart knowledge in advanced academic disciplines to meet service requirements. Programs include graduate and undergraduate education and other courses not leading to a degree.

Flight Training provides the basic flying skills needed by pilots, navigators, and naval flight officers before their assignment to operational missions.

Weapon Systems Training Subsystems Development includes the development of training subsystem (skills and equipment) required to support a weapon system. This area, and the one that follows, is not included in the FY 1976 MMTR.

Crew/Group/Team/Unit (CGTU) Training consists of training provided organized crews and units for the performance of a specific mission. It provides the necessary link between the specialized, centrally managed training activities that provide individuals the basic skills to do a job, and the operational units themselves. Examples of CGTU training are the Army's specialized warfare centers (e.g., artic and jungle warfare) and the Navy's fleet training centers that perform similar types of functions for teams of entire operational units and ship crews.

2.3 PROCEDURES

Prior to each monthly meeting, questions were developed by the appropriate chapter lead. The service representatives and staff reviewed and revised these questions to ensure that all relevant questions were asked and that the questions were presented in a manner intelligible to the services. The revised questions were then submitted to the service representatives who gathered and compiled the data. These responses were then given for review to the Task Force members, staff, and other service representatives prior to the meeting.

The service representatives and other service members and civilians knowledgeable in the specific training area under discussion met with the Task Force to clarify the written answers and to supply additional data. The format of most meetings was usually loosely structured and informal so that all participants had the opportunity to express personal points of view as well as the official service position.

As indicated in Appendix 2-1, the Task Force heard from numerous informed persons interested in Training Technology R&D. In addition to the briefings on the various functional training areas, there were special briefings by military costing personnel, laboratory directors, RAND Corporation personnel and senior military officers who had expressed interest in the activities of the Task Force. Members of the National Security

Industrial Association (NSIA) also met with the Task Force and were provided an opportunity to present their ideas on Training Technology R&D. A summary of the meeting, as prepared by NSIA, is included in Appendix 2-2. Requests for additional data were made by Task Force Members during the Task Force meetings and participants were invited and encouraged to submit other information that they believed relevant.

On several occasions, it was necessary for Task Force members to visit selected military installations for additional data. On-site visits and both informal discussions and formal briefings with operational personnel frequently provided insights that could not be obtained from written responses or full Task Force hearings.

In March 1975, drafts of each chapter were submitted to the complete Task Force and staff for revision and editing. The revision process continued until final editing by the Task Force Chairman in May 1975. The service representatives were also given an opportunity to review the final draft and correct any factual errors. The final report was submitted in June 1975 to the Chairman of the Management Panel, Defense Science Board.

The material submitted to the Task Force has been organized in an Annex to the report. One copy of this material, which is quite voluminous, has been filed with the Defense Science Board Secretariat, and is available for examination.

2.4 APPROACHES

Similar questions were asked in each of the training areas in order to maintain a consistent approach in addressing those issues specifically charged to the Task Force. The questions were organized into the nine categories described below.

Scope of Training Requirements and Costs

The intent of this section was to place into perspective the scope of the training requirements through examination of the training loads and training costs. Data for FY 1973 through FY 1980 was requested, but the services were unable to provide accurate projections beyond FY 1976 and FY 197T.

Description of Training Programs

Questions in this section provided the Task Force with an understanding of how the specific type of training was being accomplished. Requested information included course content, program locations, costs and student flow. The costing information was desired to provide a basis for further analysis, if needed, and to give an indication of relative size of different facilities and training programs.

Scope of Training Technology R&D Support

Data gathered in this section provided the Task Force with an understanding of the Training Technology R&D that is being conducted in support of training requirements or programs. The services were requested to supply descriptions of current R&D programs, including title, purpose, duration, cost and outcome.

Establishing Training Technology R&D Requirements and Priorities

This section was intended to provide a description of the establishment of R&D requirements, and the differences in perception among the R&D and user communities of how the system presently operates. Typical questions asked in all the training areas were:

1. How are Training Technology R&D requirements established, validated, and prioritized?

2. What part does the Training Technology R&D community play in establishing requirements?

3. How could the system of establishing R&D requirements and priorities be improved?

4. What are the R&D requirements not now being met?

Technical and Administration Capability in R&D on Training Technology

The Task Force inquired about the R&D programs supported by the services and DARPA in all areas of training technology. This includes such work as training procedures and equipment, professional development and education, measuring the effectiveness of various instructional strategies, and managing the training of large numbers of personnel. Attention was given to the relevance of the R&D programs to military requirements, the probable utility of the results and the prospects for their implementation, the resources provided to conduct the R&D and the steps that might be taken to improve the quality of the R&D. This would include the management of R&D activities, the coordination of research by the services, the extent of duplication and/or gaps in the topics being studied, the responsiveness and timeliness of research results, and the possibility of re-orienting R&D activities concerned with training and of consolidating some of the facilities.

Application and Implementation of Training Technology R&D

The purpose of this section was to provide a description of the process of implementation of R&D results and the perception of this process by the R&D and user communities. Specific questions were:

1. How are Training Technology R&D results currently introduced?

2. What role does the R&D community play in this transfer?

3. How could the system of application and implementation be improved?

Alternative Approaches to Management of R&D

The intent of this section was to explore the alternate R&D management approaches which could possibly increase training effectiveness and efficiency and/or reduce training costs. The approaches considered by the Task Force were: (1) single DOD facility, (2) lead service, (3) separate, but cooperative and coordinated efforts among the services and Defense agencies.

Issues Unique to the Particular Training Area

Included in this section were questions specifically applicable to the particular training area under examination, but relevant to the overall mission and objectives of the Task Force.

CHAPTER 3

RECRUIT OR BASIC INDIVIDUAL TRAINING TECHNOLOGY*

3.1 INTRODUCTION AND DEFINITIONS

The first formal exposure to military life for all enlisted military personnel occurs during recruit training. Although recruit training for the services varies in length, each utilizes the time available to transmit "essential skills and knowledges, to condition the recruit physically, and to provide an orderly transition from civilian to military life, including testing and classification, health care, clothing issue, and record preparation." Further screening as to adaptability to military life occurs throughout this recruit phase. The inclucation of attitudes, customs, mission, and traditions pertaining to each service is shared as a goal. Important goals of recruit training include adaptation, screening, and preparation for membership in the service.

In its review of recruit or basic individual training, the Task Force focused on this initial military experience in terms of both the scope of the activity and the methodology employed to achieve the stated goals. Consistent with the Task Force mission, the role of the Training Technology R&D community in assisting the services in achieving their goals was examined.

To provide the Task Force with up-to-date information, each of the services was asked to respond to a series of questions concerning recruit training. Questions were of two types: (1) descriptive information about recruit training operations to include scope, content, costs, instructional methodology, attrition, and evaluation, and (2) process information to include how R&D requirements are established, how changes occur, how this initial phase of training relates to later phases, and how the Training Technology R&D interfaces with these processes. Suggestions were solicited as to how these procedures and processes might be improved.

3.2 SCOPE OF RECRUIT TRAINING REQUIREMENTS AND COSTS

The training loads for recruit training during the period FY 1973-FY 1978 are shown in Table 3-1, and the costs and cost estimates of recruit training for FY 1973-FY 197T are presented in Table 3-2. The figures in parentheses show student pay and allowances included in the figures immediately above.

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*Howard H. McFann

TABLE 3-1

TOTAL TRAINING LOADS, RECRUIT TRAINING, FY 1973-FY 1978

Service/Component	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T	FY 1977	FY 1978
Army, Active	39,119	26,088	27,325	23,570	25,650	25,490	22,650
Army, Reserve	1,861	751	2,205	2,490	1,860	2,810	2,980
Army National Guard	5,108	3,272	4,042	4,034	4,514	4,164	4,059
Navy, Active	17,578	16,252	19,283	19,170	21,688	20,328	19,553
Naval Reserve	436	386	473	337	424	361	367
USMC, Active	15,806	12,409	14,998	13,549	13,608	13,226	12,928
USMC Reserve	2,308	905	1,197	1,763	2,088	1,866	1,866
Air Force, Active	11,561	9,797	9,706	9,825	10,908	9,825	9,825
Air Force Reserve	180	162	307	364	388	362	362
Air National Guard	510	228	387	644	712	686	686
DoD, Active	84,064	64,546	71,312	66,114	71,854	68,869	64,956
DoD, Reserve	4,785	2,204	4,182	4,954	4,760	5,399	5,575
DoD, National Guard	5,618	3,500	4,429	4,678	5,226	4,850	4,745
TOTAL	94,467	70,250	79,923	75,746	81,840	79,118	75,276

TABLE 3-2

RECRUIT TRAINING COSTS, FY 1973-FY 197T
($ Millions)

Service	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T
Army	505.3 (234.5)	670.1 (271.3)	725.1 (336.2)	771.8 (312.6)	172.7 (85.6)
Navy	144.8 (100.3)	176.6 (135.4)	211.1 (156.6)	213.3 (155.8)	64.3 (49.2)
USMC	176.8 (94.1)	150.8 (95.5)	182.8 (126.0)	176.1 (119.3)	45.6 (30.6)
Air Force	114.8 (70.8)	101.9 (59.1)	112.2 (65.9)	129.0 (70.8)	32.4 (20.2)
DoD	941.7 (499.7)	1099.4 (561.3)	1231.2 (684.7)	1290.2 (658.5)	315.0 (185.6)

DoD cost per graduate of Recruit Training for FY 1976 is $2895. DoD cost per day per graduate of Recruit Training for FY 1976 is $53.51.

The length of training varies among the services even though they all share common objectives of transitioning recruits from civilian to military life and instructing the recruits in the basic required skill. The variation in course length exists primarily because of the different degrees of service-wide skills required by each of the services. There is also a different approach taken by each of the services as to the amount of required skills provided in recruit training. The bulk of required skills is provided in recruit training by some services, while others defer it to later programs such as specialized skill training.

The length of the standard recruit training courses in each service is shown in the following table:

Recruit Training Course Length FY 1976 (Weeks)

Army	Navy	USMC	Air Force
7	9	11	6

The average length of time spent in recruit status may be longer than the standard course lengths discussed above. Some recruits fall behind their peers because of illness. Others require remedial training. If this cannot be accomplished by additional instruction, the recruit may be sent to a special training unit or recycled to a following class to repeat a portion of the course.

3.3 DESCRIPTION OF TRAINING PROGRAMS (AND RECONCILIATION OF COSTS)

All Air Force recruit training is conducted in 6 weeks (30 training days) at the Air Force Military Training Center, Lackland AFB, Texas. Because there are few basic skills needed by all recruits, course content concentrates on indoctrination subjects rather than Air Force-wide requirements. The curriculum consists of 159 hours of military training and 243 hours of transition training. Approximately one week, scattered throughout the training period, is devoted to administrative matters such as processing, classification, and assignment procedures.

Navy recruit training is nine weeks in length and is conducted at three Naval Recruit Training Centers located at San Diego, California; Great Lakes, Illinois; and Orlando. Florida. Recruits are generally drawn from adjacent geographical areas, except that all female recruits are assigned to the Naval Recruit Training Center, Orlando. The curriculum is composed of 45 days of Basic Military Training (MBT) and 8 days of physical

conditioning and military indoctrination. BMT is designed to instill an acceptance of appropriate authority in the recruit and to familiarize him with the Naval organization, military justice, basic equipment, and shipboard procedures. Military indoctrination includes the compilation of military service records, uniform distribution, and medical/dental screening and treatment.

The Army administers Basic Combat Training (BCT) for men and Basic Training (BT) for women, both being 6 weeks and 6 days in length. BCT is conducted at 6 locations throughout the country. The curriculum consists of Combat Skills and Techniques (55 hours), Fundamentals of Soldiery (57.5 hours), Physical Training (37 hours), Weapons Training (84 hours), Testing (20 hours), and Administrative time (61.5 hours). Basic Training for women is conducted at Fort Jackson, South Carolina and Fort McClellan, Alabama. The training includes General Subjects (76 hours), Administrative Subjects (69 hours), Drill and Ceremonies (32 hours), Responsibilities of Enlisted Women (17 hours), Human Relations Instruction (7 hours), Protective Training (54 hours), Professional Development (15 hours), and Proficiency Testing (22 hours), and Weapons Training (40 hours).

All of the services conduct special remedial programs for recruits who need additional training in such areas as reading proficiency, military subjects, motivation, and physical conditioning. The Army has programs in each of these four areas for trainees who do not meet prescribed standards while in Basic Combat Training. During FY 1974, approximately 8700 Army personnel were enrolled in special training programs and 85 per cent completed the programs. The Army literacy program occurs at the end of BCT with the purpose of increasing reading levels to at least the seventh-grade level.

The Navy conducts literacy training programs at the three Naval Recruit Training Centers with the purpose of increasing reading levels to at least the fifth-grade level. Annual input is approximately 1500 with an estimated cost of $1 million per year.

The Air Force has special training units in Reading Proficiency, Correctional Custody, Physical Conditioning, Motivation, and Personal Development. The Reading Proficiency Unit is a concentrated reading-training program for those unable to read to a sixth-grade level. The Correctional Custody Unit provides for rehabilitation of basic trainees with minor disciplinary problems (Article 15 cases). The Physical Conditioning Unit provides a concentrated body conditioning program for those unable to meet physical standards. The Motivation Unit is designed to improve the attitude of recruits exhibiting a poor attitude toward basic training and the Air Force. The Personal Development Unit attempts to build confidence and facilitates adjustment to the military. Average loads and estimated costs of maintaining and supervising these units are:

Special Unit	Average Annual Load	Estimated Annual Cost
Reading Proficiency	450	$ 103,600
Correctional Custody	100	72,800
Physical Conditioning	900	83,000
Motivation Unit	650	66,000
Personal Development	450	64,000

The training methodology used in recruit training varies widely among the services. The Army stresses utilization of performance-based training and attempts to minimize use of lectures and demonstration. Testing is primarily criterion referenced of an absolute nature. The Air Force and Navy extensively use the lecture approach to training with a normative evaluation process that is a combination of written/performance tests.

3.4 SCOPE OF TRAINING TECHNOLOGY R&D SUPPORT OF REQUIREMENTS AND PROGRAMS

Part of the Task Force examination of this initial phase of training included querying the services on R&D activities previously undertaken, those currently under way in FY 1975 and requirements that are not being met.

Air Force

The Air Force response was unequivocal. There has been no Training Technology R&D support for recruit training, and there are no FY 1975 R&D programs directed toward recruit training. Further, Air Force representatives indicated there were no requirements that were not presently being met. Since they stated that the primary sources of recruit training R&D requirements are the Deputy Chief of Staff/Personnel and the Air Training Command (ATC), the conclusion is that the operational personnel have not and do not see a need for R&D on recruit training. Evidently the R&D community holds the same perception, since the Air Force response stated, "The R&D community assumes a large and complex role in establishing requirements. A first contribution comes from the products of a basic R&D discipline; i.e., a systematic comprehensive knowledge of training state-of-the-art, to include both the software and hardware aspects of training. A second contribution involves a direct interaction with the customer helping him to objectively define training needs in light of potential improvements." Though not part of any effort supported by R&D funds, the Air Force did cite a major Systems Approach to Training or Instructional Systems Development (SAT/ISD) project directed by ATC which is designed to provide a systems approach to all Basic Military Training School courses.

Navy

R&D on training of recruits under the aegis of the Office of Naval Research (ONR) and the Navy Personnel Research and Development Center (NPRDC) was described as having been sporadic over the years. Previous Training Technology R&D has dealt with the development and evaluation of comprehensive achievement tests, literacy preparatory training, and as part of Project One-Hundred-Thousand, experimentation on the effects of different instructional approaches on the acquisition of a variety of skills and knowledge by Mental Category-IV personnel.

ONR's research in training and education, exclusively supported with 6.1-Research funds, is usually not directed at problems associated with any particular type of training. Rather, ONR-supported research develops, through contracts, a technology base for the field in general, and this technology base is then applied wherever appropriate. Thus, there has been limited technical R&D for recruit training per se. Consistent with this approach, ONR has no research directly related to recruit training for FY 1975.

The majority (62 per cent) of NPRDC R&D pertinent to recruit training is done in-house, with the remainder accomplished by contract. About 58 per cent of the efforts are in the 6.2-Exploratory Development funding category and 34 per cent in the 6.3-Advanced-Development category. There is no recruit training 6.1-Research effort at NPRDC. About 8 per cent of the work is on a specific reimbursable basis. For FY 1975, NPRDC has under way the following activities directly related to recruit training:

A. As part of Project PLATO IV, three Advanced Development programs are under way: the first is aimed at training interpersonal behavior between recruit and trainer; the second is a study concerned with attitudes and belief systems of company commanders; a third study is attempting to develop measuring instruments for predicting successful functioning in the role of recruit company commander.

B. In the linguistic or reading remediation area, three efforts supported by NPRDC are in process: one involves employing CAI for phonics training; the second is employing compressed speech to improve reading rate; and the third is an extensive training-reading-measurement program designed to identify recruit candidates for reading-remediation training and as a basis for the design of recruit reading materials.

C. The final NPRDC FY 1975 effort is an evaluation of recruit-training effectiveness. This program is aimed at comparing attitudes and performance of 9 and 7.6-week graduates, as well as determining the current status of recruit-training effectiveness. In June 1972, the Chief of Naval Education and Training (CNET) extended recruit training from 7.6 to 9 weeks. Prior to this change, CNTECHTRA conducted a survey, via a questionnaire, of recruits, recruit-training graduates

and their supervisors, and commanding officers of ships to obtain an evaluation of the effectiveness of the 7.6-week-length recruit-training curriculum. The results of this survey and the instruments employed have been furnished to NPRDC to provide a basis for comparing the effects of the shorter versus longer curricula. These instruments together with some additional questions to provide a general overview of the present status, are being administered to 9-week recruits, recruit training graduates enrolled at 17 Class "A" schools, recruit graduates who went directly aboard ship and have been there three to six months, their supervisors, and also to Class "A" school instructors and commanding officers of ships to determine how these instructional and supervisory personnel view these graduates of the longer 9-week recruit-training curriculum.

This final NPRDC FY 1975 study is described in some detail because the implication of change of this magnitude has considerable impact on availability of personnel for fleet assignment and on cost of training. Some facts bear comment: first, the study is funded by O&M, not R&D funds; secondly, the R&D community was brought in <u>after</u> the initial baseline data were obtained and thus made little input to instrument design, methodology, or experimental design; and thirdly, measurement of both attitudes and performance relies almost exclusively on questionnaire responses. The study represents a classic example of where cost-effectiveness information would be of value, but it is not provided. The training cost represents millions of dollars as well as approximately three quarters of a million training days annually--days in which personnel are delayed from joining their operational units. As described, the effectiveness data would appear to be lacking both in providing overall effectiveness and delineation of what, if any, changes might be required. As difficult and expensive as it is to obtain quantitative information on effectiveness, the effort and expense would appear to have been warranted in this instance.

The Navy gave no indication that there were any outstanding R&D requirements for recruit training that are not being met.

<u>Army</u>

Army R&D for recruit training is performed under the auspices of the Army Research Institute for the Behavioral and Social Sciences (ARI). The Human Resources Research Organization (HumRRO) continuously, since 1952, has carried out the Army's training technology research for basic training. From 1952 to 1 June 1972 HumRRO performed this function as a Federal Contract Research Center (FCRC) and since 1972 has operated under contract with ARI.

Army R&D activities have included the study of recruits' reactions to basic training, follow-up studies of recruits during their first tour, determination of training goals for Basic Combat Training, and development

of specific courses of instruction on such subjects as day and night marksmanship, land navigation, and leadership instruction. In addition, R&D has included the study of various evaluation procedures and techniques, the possible need for different types or amounts of training for recruits of differing abilities. Also, the study has been made of various incentives and management procedures as related to performance of recruits to include the effects of shortening Basic Combat Training, as well as the feasibility of combining Basic Combat Training with Advanced Individual Training.

Within the last few years, partly in preparation for the Volunteer Army, there has been substantial R&D support toward the revamping of basic training for male Army recruits and to develop new literacy training programs for recruits. The focus of both efforts has been to make the training more job-related, performance-based, and criterion-referenced. The most recent study, which led to a revision of Basic Combat Training (BCT) for male recruits, was conducted under the ARI project called ATC-Perform (Ref. 1). The program involves specification of course objectives and development of criterion-referenced (go/no go) tests. Both objectives and standards for course completion are shared with students and instructors. Content is organized into functional job- or task-related blocks and instruction emphasizes "hands-on" practice. Within an instructional block, individual differences are accommodated by permitting the trainee to "challenge" the test when ready and by the use of the more able student to assist the less able. Graduation from basic training is permitted only after the trainee has successfully passed all performance tests for each subject matter area. The R&D work underlying the literacy training program was conducted under the ARI project called Job Functional Literacy (FLIT) (Ref. 2). The Army's FY 1975 R&D program on recruit training includes an extensive revision of WAC Basic Training to make it performance oriented, and a study of BCT skill retention under ATC-Perform.

In the area of literacy training, further work on developing and implementing the FLIT program is continuing at Army Training Centers. FLIT training is conducted after the recruit has completed basic training, when he has been informed about his job assignment, and the training material is oriented toward the concepts, vocabulary, and reading tasks required for the job for which the recruit will be trained. Both FLIT and ATC-Perform are funded as part of ARI's 6.3-Advanced-Development contract activities.

The Army's extensive R&D efforts on basic training have emphasized how the training can best be done and the appropriate evaluation procedures to be employed. Much less attention has been given to what should be taught in Basic Combat Training. As with the other services, the content of basic or recruit training is primarily based on professional judgments, opinion, and tradition. In addition, for the Army a major constraint on basic or recruit training has been, and presently is, dictated by Public Law 82-51. This public law requires that every person inducted into the armed forces under provisions of the Universal Military Training and Selective Service Act should be given adequate military training

for a period of not less than four months, and that no person shall, during this four-months period, be assigned for duty outside the United States, its territories and possessions. Thus time, not proficiency, was selected as the best measure available to guarantee sound training. P.L. 82-51 serves as a major constraint on the services gaining full benefit from advances in training technology developed over the past twenty years, especially those advances associated with evaluation and individualization of training and self-pacing. Action has been initiated by DoD to obtain relief from this constraint.

ARI indicated to the Task Force that at the present time all requirements in recruit training that have been received from field operating agencies are being met. However, they cited possible areas for additional R&D in recruit training to include the effects of the trainer, such as the Drill Sergeant, on the performance and adjustment of individuals, and the effects of grouping (as by physical ability, mental ability, career field, or other factors) on the effectiveness of training. These areas would initially be funded as 6.2-Exploratory Development since the parameters would need to be established before the areas could be further evaluated for operational effectiveness under the 6.3-Advanced-Development funding category.

3.5 ANALYSIS AND EVALUATION OF CURRENT EFFECTIVENESS OF TRAINING TECHNOLOGY R&D PROGRAMS AND MANAGEMENT

Establishing R&D Requirements: Present Procedures

Each of the services has an orderly, formally established procedure for determining, validating, and prioritizing human resources R&D requirements. Operationally, for recruit training, the procedures emphasize user-established requirements. The R&D community seems to have a more informal or advisory role. This is especially so for Exploratory (6.2) and Advanced Development (6.3) activities. All services maintain records on their on-going programs and initiate minor changes throughout the year. Through semi-annual or annual conferences an overall evaluation of the effectiveness of recruit training is accomplished together with a determination of content and required training changes. Also, each service conducts studies on an aperiodic basis. However, the R&D community seems at best to have only a tangential role in the deliberations. In addition, somewhat uniquely for recruit training, service higher headquarters, or DoD, directs selected training content and suggests, if not directs, the procedures to be employed, e.g., code of conduct, drug abuse, and race relation. Thus, a portion of recruit training is mandated and is not to be modified so far as the operational commander is concerned.

Although in theory the R&D community can initiate requirements by interacting with and persuading the user that he has a need for some specified R&D effort, in fact, the R&D community has had little impact on the establishment of requirements for recruit training. The exception to this is 6.1-Research-funded projects where, for the most part, requirements are internally generated by the R&D community.

That such has been the case has been recognized by the Army through its recent establishment of ARI field units. An active responsibility of the field units is to solicit requirements. Whether this move will permit the R&D community to initiate requirements better remains an open question.

Implications of Present Procedures

The existing procedures of the services, which place major responsibility on the operating command for assuming the advocacy of a requirement, has a series of profound implications, at least for recruit or basic training. Understandably, the recruit commander views possible research problems from the perspective of his own area of responsibility. His attention tends to be focused on ensuring maximum output from the current subsystem of recruit or basic training. Though generally admirable, such a perspective can have deleterious effects. If personnel successfully complete this initial phase of training but "fail" or perform poorly later in the system, then a considerable cost to both the service and the individual may result from actions taken to get the individual through during this recruit phase. The existing procedure for obtaining data on the long-term impact of recruit training is that of "feedback" from the field or the using unit; unfortunately, this information is primarily impressionistic and fragmentary.

A second implication of the almost exclusive emphasis on "user" established requirements (which usually originate with the recruit-training commander) is an emphasis on "micro-studies" and maintaining the "status quo." This is not surprising since career and assignment policies necessitate command change every two or three years. Understandably, the commander is oriented toward his area of responsibility within the system in the present and near future, i.e., during his tour of duty in the assignment, and he tends to see requirements from that perspective.

A third implication is on the conceptual side. The commander is rarely a trained researcher or knowledgeable in detail on the technical content or methodology of R&D. Experience indicates that an operational problem or identified symptom often requires restatement or embodiment within a larger context before an R&D problem can be delineated. Early involvement of R&D personnel in translating operational problems into R&D questions would appear advantageous. Such activity should prevent undertaking R&D of minor consequence or potential, as well as preclude unnecessary duplication or repetition. Further, a reasonable expectation is that the R&D community should be responsible for initiating and conducting the larger systemic studies since it should have the required continuity of interest, expertise, and overall system perspective. Present procedures for initiating requirements do not appear to foster such involvement of the R&D community in determining requirements for Exploratory Development (6.2) and Advanced Development (6.3) funded activities.

Obtaining requirements, determining priorities, and developing R&D

programs generally occur on an annual basis tied to the ODDR&E funding cycle. For human resources, the procedure appears to be one in which requirements are matched against previously determined fiscal allocations. Usually, requirements exceed resources resulting in competition among requirements and the determination of a fairly fixed program. Thus, if new requirements of a higher priority occur during the year, the approach usually is to "knock out" already established R&D activities, or to delay initiation of other needed R&D. Also, the higher priority human resources R&D requirements tend to be those with more immediate impact and of short duration; this tends to push training technology R&D requirements toward problems that should be worked on with R&D at the Advanced Development (6.3) and Engineering Development (6.4) categories. The longer-term Research (6.1) and Exploratory Development (6.2) activities tend to receive the lower priorities; indeed, they might be overwhelmed into disappearance were it not for the autonomy retained by the R&D community for R&D efforts in these categories.

The nature of Training Technology R&D has implications that bear both on the work undertaken and the utility of findings. Since Training Technology R&D usually requires the study of human subjects and the intervention or change in existing training activities, there is often a reluctance on the part of the military to support "high-risk" studies, or major innovation and change in existing training programs. Therefore, the R&D conducted often is of a very conservative and evolutionary nature, or is sufficiently separated from existing operations that determination of possible impact is difficult to ascertain. For that reason, conceptual training technology research (6.1 funded) is most often accomplished with non-military personnel.

Where the possible impact of change on operational performance can be more readily ascertained (e.g., pilot or individual skill training), priorities are relatively easy to establish. However, since a considerable part of recruit training is on attitude development or on preparatory skill development required for all enlisted service personnel, the demonstration of operational relevance is difficult. Also, because all personnel undergo this activity as their intial experience in the military, there is a reluctance to modify or change traditional content or procedure. Such may well explain why the content of such training has remained fairly constant for all the services. This might also partially explain why the Air Force has no Training Technology R&D requirements for recruit training and why the Navy has undertaken R&D in this area only on a sporadic and limited basis. In contrast, the Army has had a continuous and fairly extensive Training Technology R&D program for basic training. For a period of years there was agreement between the operational command (CONARC) and the R&D community (HumRRO and the Army Research Office at DA) that a prescribed amount of R&D (approximately 300 thousand/year) would be devoted to basic training and that troop and resource support would be provided. Further, an R&D activity would be co-located with an operational activity (training center) for carrying out the R&D and facilitating the implementation of tested programs and procedures for use at all training

centers. Also, significant to the Task Force considerations is that the Army's decision to devote continuous effort through this arrangement permitted R&D personnel to observe recruit training over a long period of time and assist in formulating R&D requirements.

Focus and Extent of Recruit Training R&D

Considering the relative level of expenditure in dollars and personnel involved in recruit or basic training, R&D in this area has had a remarkable paucity of attention. Apparently, few or no attempts have been made by either the Air Force or Navy for R&D to investigate the effectiveness of their instructional methods. The Army alone, of the three Services, has initiated Training Technology R&D to permit development of more efficient training methods applicable to recruit training.

None of the services appears to have examined substantially through R&D the necessity for the subject matter included in recruit or basic training. The assumption appears to be that the existing content has been and continues to be necessary; e.g., weapons instruction, dismounted drill, and first aid are all accepted as necessary for all. None of the services has undertaken longitudinal studies that would permit the determination of the contribution of components of recruit training on attitude development or later performance; e.g., the Air Force's one-day weapons instruction is viewed as primarily motivational, yet the long-term effect of this experience is apparently unknown.

Little is known by any of the services of the criticality of, or the retention of skills and knowledges acquired in basic training. For example, if skills learned in recruit or basic training are fragile and susceptible to rapid forgetting, then questions arise as to whether such skills should be taught, or if taught, to what level of proficiency. Conceivably, if such skills are critical to later performance, higher standards, over-learning, or integration with follow-on training might be more appropriate. Also, if the primary emphasis of recruit training is to be on attitude development, little information exists on the comparative effectiveness of approaches other than those used presently for developing the desired attitudes. That the services differ in methods of achieving their goals is apparent; that one approach is more effective or advantageous than another is both unknown and apparently uninvestigated .

Although the Army attends a bit more than the other Services to accommodating individual differences during training, the handling of individual differences by all of the services is fairly similar. Within an institutional block the Army has a greater emphasis on student-centered instruction as compared to instructor centered. The general approach is to organize the recruits into small units and have them proceed through training in a single-track fixed-time mode.

Those trainees who have difficulty in achieving established goals are either recycled through part of the training, or provided remedial

instruction. An outstanding exception is the literacy-remediation program of the Army where the instruction is geared to the students, and standards are based upon future advanced individual training and job requirements (Ref. 2, 3, 4). To a considerable extent, the single-track fixed-time approach appears to be dictated by P.L. 82-51, a legal constraint, and by assignment procedures, an administrative constraint. Although there apparently is strong advocacy for existing practices, few data are available to support them as the "better" approach. What information does exist tends to show attitude deterioration during basic or recruit training with the greatest deterioration occurring with the more able recruit (Ref. 5, 6, 7).

Evaluation of performance by the Navy and Air Force are similar--evaluation of academic material by paper-and-pencil tests and evaluation of other performance goals through ratings by first-line supervisors (NCO's or Chiefs). As a result of Training Technology R&D (ATC-Perform), the Army now employs a mastery-performance basis for evaluation of academics--a method that incorporates objectives and standards, and that requires each trainee to reach a standard of performance in each skill prior to graduation (Ref.1). Thus, there is assurance that upon graduation from basic training each trainee does in fact know certain things and can do certain things to a required level of proficiency. In addition, the first-line supervisors judge for other performances and adaptability.

Application and Implementation: Present Procedure

At a formal level, the results of Training Technology R&D are implemented at the direction and under the guidance of the training command headquarters. Since the Air Force cited no instances of R&D, comments on utilization of Training Technology R&D for recruits must be restricted to the Navy and Army. For the Navy, the procedure to utilize R&D is the province of CNET, and the role of the R&D community is to provide limited consultation. For the Army, the Infantry School, the proponent school for basic training, and TRADOC Headquarters are involved in the decision process on utilization of Training Technology R&D. During the current changeover to performance-based training and evaluation, the Army R&D community has provided services and products in the form of training materials, training guides, workshops, and extensive technical advisory services. The Army's approach has been to have the R&D personnel work in close proximity with the operational command during both the R&D phase and in the utilization and implementation of findings. This approach, although very effective, does raise the question of the degree to which the R&D community should participate in implementation and the extent to which RDT&E funds should be committed to such activities. This may be the "price to be paid" in order to assure that such findings are used; alternately, O&M funds might be provided to support additional involvement of the R&D community in implementative activities.

The operational arms of the services, especially for 6.2- and 6.3-funded activities do commit themselves as to their need for specific research and the value of the information to be obtained. However, there

appears to be no formal mechanism for assuring either utilization of findings or the maintenance of change once accomplished. In contrast to the fate of new hardware when it replaces old items in the inventory, much of the training technology implementation is susceptible to "wash-back" to the old methods because new practices are accomplished by people who change both in their ideas and assignments. An example of this phenomenon occurred with the Hawk Radar Mechanic. R&D accomplished in conjunction with the Air Defense School (USAADS) demonstrated that attrition could be reduced with no loss in proficiency, and that these findings were maintained when the training was managed completely by USAADS (Ref. 8). Adoption of this program, which included integrating basic electronics training within the context of training on the radar, occurred in the 1968-69 time frame. Special labs were built to include instruction and installation of special signal-generation sources. In addition, instruction on student manuals, POI's and training aids were developed. The personnel responsible for the initial R&D effort worked closely with school personnel until full implementation occurred. In the early 1970's, a decision was made to move away from the job-oriented, functionally integrated program and return to the lockstep approach of a block of instruction on general theory before training on the radar. Exactly why is not known, but clearly people had changed from training technology implementation to "washback."

Factors Influencing Utilization

Whether or not the results of technical training R&D are utilized appears to depend upon several factors: first, the urgency of the problem to which the findings might apply; secondly, the specificity of the R&D to an identified problem; thirdly, the scope of the change required; and fourthly, the timeliness of presentation of the findings. Since R&D findings have to be translated into operational options, the involvement of R&D personnel in this process would appear to be beneficial. Unfortunately, too often this does not happen primarily because the decision-maker is unaware that the R&D community has information that might be of value. Also, there is a general unawareness of the potential value of recruit Training Technology R&D because usually the R&D already accomplished loses identity when it has been implemented. Often no one remembers or has ever heard of the R&D efforts on which current practice is based. Institutional memory appears to be quite short. The fifth factor is the manner in which the R&D findings are presented to the decision-maker. Ideally a decision function presenting cost-effective data on the choices would be made available. The nearest approach to this ideal in recruit training R&D is in cost-effective point data; e.g., presenting the cost-effectiveness of varying training times or instructional approaches rather than just a single comparison. For the most part, R&D findings have been presented in effectiveness terms, with little to no attention given to cost other than to indicate they would not be greater. A general complaint from the user is that findings are presented in either such a tenuous or complex manner that utilization is hindered or precluded. R&D reports are too often written for other R&D personnel, not for the intended R&D users.

A recent instance of application of Army Training Technology R&D for recruit training illustrated many of the above points. It also shows the potential for substantial pay-off for training R&D. As part of its commitment to increase training efficiency and effectiveness, TRADOC is studying the possibility of integrating the 7 weeks of Basic Combat Training (BCT) and 8 weeks of Advanced Individual Training (AIT) into One Station Unit Training (OSUT) of 12 weeks for Infantry, 13 weeks for Armor and 14 weeks for Artillery to replace the present fifteen-week sequence of BCT and AIT. This specific alternative of combining basic and advanced training was addressed by the R&D community for a combat-support training course six years ago (Ref. 9), fifteen years ago for Armor training (Ref. 10),and two years ago for Infantry training (Ref. 1). Fortuitously, there existed sufficient institutional memory in both the operational and R&D communities that senior personnel at TRADOC could be apprised of the findings and provided valuable data bearing on this question.

The information required for the decision-maker (CG, TRADOC) involved summarization of some seven studies dating from 1955 to present on-going research (Ref. 11, 12, 10, 9, 1, 13). As a result of direct interaction between R&D personnel and TRADOC policy makers, the decision was made (by CG, TRADOC) that the R&D findings would be incorporated into, and serve as a basis for, the recommendation that such integration of training occur. A major factor facilitating this decision process was that the R&D information was organized to focus on the operational question and was presented in cost-effectiveness terms. It was organized for the decision-makers, not for R&D personnel. The potential pay-off of this implementation is over $6.0 million per year in savings of training costs, savings of over 2,600 trainee man-years per year, and release of some 296 permanent-party training-manpower spaces for use in operational units.

In the above instance, the R&D had been accomplished, the findings were retrieved, and since there was a history of interaction between R&D and operational personnel, timely communication occurred.

There appears to be a need for continuous interfacing of the R&D and operational communities. Such personnel should be cognizant of operational problems on the one hand, and they should have access to completed or on-going findings and R&D personnel that might be brought to bear on the operational problems. These "brokers" need to have access to both operational policy makers and R&D managers. If the R&D community was knowledgeable about, and participated in, providing information for policy decisions, then there likely would be greater utilization of R&D, more decisions would be based upon data, and greater support for R&D efforts to explore more general problems.

The acceptance and implementation of R&D findings are dependent upon the consequences for the operational commander. For the commander of a recruit training center, emphasis on increased proficiency and reduced attrition appear to be of priority importance. Reductions in training

time (which could result in large overall savings as indicated above) generally do not enjoy the same priority. This is in part explained by the present accounting procedures that base indirect budgets partially on direct personnel costs, and thus act as a negative incentive for the commander to emphasize reduction in training time or acceleration of trainees. Consideration should be given as to how the recruit training commander could share the time or personnel savings resulting from implementing efficient procedures.

3.6 CONSIDERATION (ANALYSIS AND EVALUATION) OF ALTERNATIVE MANAGEMENT APPROACHES AND STRUCTURES (COST-EFFECTIVENESS CRITERIA)

The services were all adamant in their position that recruit or basic training was sufficiently unique that there was no possibility of common recruit training for all services. The R&D perspective of the services' responses fairly well parallel the operational approach. Since the Air Force reported little to no R&D on recruit training, and the Navy only sporadic and limited efforts, there exists no data base on which to compare alternative managerial approaches to recruit training. However, examination of the programs of the services does show some communality. All are involved with attitude development, imparting of basic skills and knowledges, and remediation programs, e.g., literacy.

For conceptual R&D activities at the 6.1-Research level, it would appear that either a centralized DoD activity, or lead-service approach, might be advantageous; e.g., in methodological research required for longitudinal studies, and in basic attitude research.

For Exploratory Development (6.2), a lead-service concept would appear reasonable. For example, all services are faced with literacy problems. Also, all services incorporate physical fitness as an integral component of recruit training, and they all are interested in developing discipline.

In contrast, Advanced Development activities (6.3), do appear to be service-specific since these development activities must deal with engineering and testing programs applicable to the specific service in question.

Since the Army is the only service that has had anything approaching a continuous R&D program on basic training, it is not surprising that it also has a greater history of utilization of R&D. As such, Army R&D appears to be in the best position to assume the role of a lead service in 6.2-Advanced Development efforts on recruit training.

3.7 CONCLUSIONS

1. The justification for undertaking Training Technology R&D for recruit training is threefold: (a) all enlisted persons experience it, (b) this phase of training involves indoctrination into the military service, and preparation for later training, and ultimately operational capability, and (c) the cost of this training is considerable because of the large number of trainees involved and the sizable attrition rates among first-term personnel.

2. All indications are that the training commands have attended to these matters to some extent over the years, but that the R&D communities of the services have had different degrees of involvement. The Air Force reported no such research, the Navy sporadic, and the Army reported sustained involvement with an emphasis on instructional methods and evaluation procedures.

3. Training Technology R&D requirements for recruit training have emphasized improvement of the existing system within fairly constrained limits. The quality of requirements reflects the degree of interaction between the R&D community and the training commands.

4. The impact of Training Technology R&D for recruit training parallels the R&D investment made by the services. In addition to the sustained effort, utilization of Training Technology R&D seems to require some group or agency performing the transfer function.

5. That Training Technology R&D can make a contribution to recruit training appears clear. Why this potential has not been fully realized is not so clear. Some of the factors that inhibit such realization have been discussed in previous sections of this chapter and are reflected in the recommendations. In addition, the recommendations focus on the generation of Training Technology R&D requirements, program development, and required areas of Training Technology R&D applicable to recruit training.

3.8 RECOMMENDATIONS

1. Procedures should be modified to ensure that trainee evaluation occurs by demonstrating proficiency and not time. DoD should request that modifications be made in Public Law 82-51, which currently utilizes time-in-training as the criterion of preparedness.

2. Existing administrative systems should be modified to provide greater incentives to utilize R&D findings. In recruit training, the major change needed is to allow the command to share in savings accrued through innovations in training. Procedures that allow the R&D community to share in savings resulting from implementation of Training Technology R&D findings, for example, cost reimbusement for R&D personnel engaged in implementation activities, should be provided without reduction in the technology-base level of funding.

3. Alternative procedures to ensure greater likelihood of initial implementation and maintenance of changes initiated should be developed and tested. Two alternatives suggested are (a) the establishment of an R&D "broker" whose primary responsibility would be to interface with the R&D and recruit-training communities, and (b) the commitment of a proportion of R&D personnel to an implementation role on a cost-reimbursable basis.

4. Each of the services should identify and maintain Training Technology R&D for recruit training on a sustained basis. Especially required are longitudinal studies to determine the relationship of content and procedure to later success and performance in the services.

5. Present procedures for formulation of Training Technology R&D requirements and program development should be modified to provide greater involvement of the R&D community in recruit training, accompanied with responsibility, authority and accountability, to generate requirements and to undertake R&D.

6. For recruit Training Technology R&D, a lead service approach should be established for selected Exploratory Development (6.2) activities, and the assignment of initiative and leadership roles made to specific services in R&D areas such as literacy, physical fitness, and attitude development. The implementation of R&D findings should be left to each service.

REFERENCES (Chapter 3)

1. HumRRO, The Concepts of Performance-Oriented Instruction Used in Developing the Experimental Volunteer Army Training Program, Technical Report No. 72-7, J.E. Taylor, E.R. Michaels, and M.F. Brennan, March, 1972.

2. HumRRO, A Program of Army Functional Job Reading Training: Development, Implementation, and Delivery Systems, Final Report HumRRO-FR-WD(CA)-75-7, T.G. Sticht, June, 1975.

3. HumRRO, Determination of Literacy Skill Requirements in Four Military Occupational Specialties, Technical Report No. 71-23, November, 1971.

4. Thomas G. Sticht, ed., Reading for Working: A Functional Literacy Anthology, Human Resources Research Organization, Alexandria, Virginia, December, 1974.

5. HumRRO, Relationship Between Army Recruit Characteristics and First Tour Performance, Technical Report No. 69-5, J.S. Caylor, April, 1969.

6. HumRRO, A Follow-up Study of the Performance of Army Recruits in Their First Tour, Professional Paper 10-68, J.S. Caylor and H.H. McFann, October, 1967.

7. HumRRO, Recruit Reactions to Early Army Experience, Professional Paper 7-69, R. Snyder and J.S. Caylor, March, 1969.

8. HumRRO, Development of a Procedure-Oriented Training Program for HAWK Radar Mechanics, Technical Report No. 69-25, December, 1969.

9. HumRRO, Development and Evaluation of an Integrated Basic Combat/Advanced Individual Training Program for Medical Corpsmen (MOS 91A10), Technical Report 70-1, J.S. Ward, N.I. Fooks, R.P. Kern, and R.D. McDonald, January, 1970.

10. HumRRO, An Improved Advanced Individual Training Program for Armor, Technical Report No. 59, E.G. MacCaslin, A.B. Woodruff, and R.A. Baker, December, 1959.

11. HumRRO, Development of Proficiency Tests for Basic Combat and Light Infantry Training, Technical Report No. 19, R.A. Baker, G. Scott, and E.F. MacCaslin, July, 1955.

12. HumRRO, Evaluation of Four-Week and Eight-Week Basic Training for Men of Various Intelligence Levels, Technical Report 32, V.B. Cline, A. Beals, and D. Seidman, November, 1956.

13. HumRRO, Review, Evaluation and Refinement of Performance Training in Army Training Centers (Tentative Title), Technical Report in Preparation, J.E. Taylor, M. Brennan, J.E. Hungerland, W. Melching, M. Showel, and J.R. Suchman.

14. Department of Defense, ODDR&E (Environmental and Life Sciences), Human Resources Technology Coordinating Paper, Revised version, Chapter III "Education and Training," Draft Undated, (Approx. July, 1974).

15. Department of Defense, Military Manpower Training Report for FY 1975, March, 1974.

16. Department of Defense, Military Manpower Training Report for FY 1976, March, 1975.

CHAPTER 4

SPECIALIZED SKILL TRAINING *

4.1 GENERAL DESCRIPTION

Specialized skill training, for officers and enlisted personnel, provides the skills and knowledges required to operate the military forces. The range of courses offered for such training is very wide and includes, for example, basic electricity, typing, jet aircraft maintenance, law enforcement, weapons mechanic, food service, radio operation, computer systems, and nuclear reactors. Skill training accounts for about 55 per cent of the 255,000 man-years and 52 per cent of the $6.9 billion spent each year for all types of military training. The magnitude of specialized skill training is suggested by the following selected data for FY 1976.

4.2 AMOUNT AND COST OF SKILL TRAINING**

At any one time, about 140,000 enlisted and officer personnel are in various phases of skill training; the annual input is 1.3 million, of whom about 5 per cent are lost through attrition. About 7100 courses are offered, with course lengths that vary from a few days to a year; the average length is about 60 days. About 126,000 military and civilian personnel work in support of skill training at about 86 facilities. The annual funding is about $3.6 billion, of which $1.4 billion are for pay and allowances of the students. About 10 per cent of the skill training load (as well as of all training) is conducted for the reserves by the active training establishments. About 56 per cent of the training of reserves is in the specialized skill area. (See Tables 4-1 through 4-4.)

The 140,000 military man-years spent annually in skill training use up about 5 per cent of the total time available to the military forces (3.0 million men, including 0.9 million reserves) in FY 1976; this figure rises to 9 per cent when all types of military training are included.

Table 4-5 shows some trends in skill training between FY 1975 and FY 1976. Only total data for DoD are shown. Between these two years, input and output are up 3 per cent, but the load remains constant. There have been reductions in the number of courses (down 18 per cent), number of training facilities (down 3 per cent) and the number of personnel in support of training (down 3 per cent). The aggregate cost of training increased 1 per cent.

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** Detailed training load and cost data and descriptions of specialized skill training programs are presented in Appendix 4-1.

TABLE 4-1

NUMBER OF STUDENTS IN SKILL TRAINING, FY 1976

Type of training	Input	Output	Load
Initial skill training			
Enlisted	542,363	496,926	90,485
Officer	25,937	25,494	5,841
Skill progression (advanced)			
Enlisted	186,946	178,511	23,914
Officer	32,961	32,345	5,776
Functional training (other)			
Enlisted and Officer	466,193	455,038	14,448
Active Forces	(1,147,320)	(1,088,161)	(126,899)
Reserve components	(107,080)	(100,153)	(13,565)
DoD TOTAL	1,254,400	1,188,314	140,464

Source: MMTR FY 1976, Chapter V

TABLE 4-2

NUMBER OF COURSES, AVERAGE COURSE LENGTH, AND ATTRITION FY 1976 (Limited Data)

Type of Training	Army	Navy	Marine Corps	Air Force
Initial Skill Training				
Enlisted				
No. of courses	341	106	278	236
Average course length (days)	62	43	76	100
Average attrition rate	9%	8%	10%	6%
Officer				
No. of courses	-	17	61	54
Average length (days)	60	99	74	87
Average attrition rate	-	-	-	-
Skill Progression Training				
Enlisted				
No. of courses	87	1388	218	1600
Average course length (days)	63	52	74	32
Projected attrition rate	7%	6%	4%	2%
Officer				
No. of courses	16	135	85	550
Average course length (days)	32 wks	51	104	23
Average attrition rate	-	-	-	-
Functional Training				
Enlisted and Officer				
No. of courses	159	1566	191	8
Average course length (days)	56	4	37	7

Source: MMTR FY 1976, Chapter V

TABLE 4-3

SKILL TRAINING FACILITIES AND MANPOWER, FY 1976

	Schools, centers, commands	Manpower (000) in support of training	
	Total	Military	Civilian
Army	28	43.0	28.6
Navy	34	18.6	4.5
Marine Corps	15	4.9	0.6
Air Force	7	17.3	9.0
Joint	4		
DoD TOTAL	86	83.8	42.5

Source: MMTR FY 1976

Schools: Ch. IX
Manpower: p. VIII-5

TABLE 4-4

FUNDING (000,000) FOR SKILL TRAINING, FY 1975, FY 1976
(Mixed Data)

	Pay and Allowances FY 1976 (1)	Fixed Cost FY 1975 (2)	Variable Cost FY 1975 (2)	Aggregate FY 1976 (1)
Army	$ 584	($443)	($ 790)	$1,887
Navy	482	(154)	(295)	879
Marine Corps	85	(33)	(26)	154
Air Force	235	(159)	(212)	632
DoD TOTAL	$1,386	($789)	($1,323)	$3,552

NOTE: This table contains data from MMTR FY 1975 and MMTR FY 1976 which are not directly comparable. "Aggregate" applies only to FY 1976 data.

Source: (1) MMTR FY 1976, p. X-3
(2) MMTR FY 1975, p. XII-4

About 5 per cent of all DoD specialized skill training is conducted outside the parent service, about half of which is for the Marine Corps alone. The amount of interservice skill training has increased slightly (0.6 per cent) between the two years under review.

4.3 FUNDS FOR R&D ON SKILL TRAINING

The total budget for R&D on education and training appears to be as follows:

FY	Budget (in Millions)
1972	$26.4
1973	29.8
1974	36.3
1975	42.2
1976	47.5 (request)

Source: FY 1972, 1973 TCP
FY 1974 - 1976 ODDR&E, Human Resources

The composition of these budgets for FY 1974-1976 is shown by Program Areas in Table 4-6 and by service in Table 4-7.

It would be difficult to allocate these funds to skill training and the other types of training considered by this Task Force, i.e., according to the categories which appear in the Military Manpower Training Report. Although it would have been useful to relate R&D on training to its utilization in training, this Task Force has not been able to do so.

The difficulty encountered by this Task Force in evaluating the R&D program on skill training is not, in itself, intended to be critical about the quality of the R&D. Much of the R&D is known to be competent and relevant. What is obviously lacking is the information needed to assess whether the distribution of R&D funds among the various tasks in the program properly follows some relationship to the probable benefit of their results, on the assumption that the R&D would produce its anticipated results. If such analyses have been accomplished, one imagines that the services would have been proud to make them available.

Two documents published by the DoD contain information useful for describing and coordinating various efforts in training technology. These are the Military Manpower Training Report and the Technology Coordination Paper on Human Resources, which provide the data appearing in this chapter. However, the two reports describe activities related to training in categories which are not directly applicable:

TABLE 4-5

SOME COMPARISONS ON AMOUNT OF SKILL TRAINING, FY 1975 AND FY 1976 (DoD TOTALS ONLY)

ITEM	FY75	FY76	Change
Input	1,218,196	1,254,400	+3%
Output	1,151,484	1,188,314	+3
Load	140,847	140,464	0
No. of courses	8,660	7,096	-18
No. of training facilities	89	86	-3
No. of persons in support of training	130,137	126,656	-3
Aggregate cost (in $ Millions)	3,502	3,552	+1

Source: FY 1975: "back-up compilations" dated 28 April 1975 provided by Keene Peterson, Manpower Programs Directorate, OASD (M&RA)

FY 1976: MMTR FY 1976

TABLE 4-6

DoD BUDGET FOR RDT&E IN EDUCATION
AND TRAINING BY PROGRAM AREAS, FY 1974-1976 ($ Millions)

Program	Fiscal Year 1974	1975	1976 1976T
Planning & Evaluating Training Programs	1.8	1.9	2.1
Design of Education and Training Media	3.1	4.0	4.5
Trainee Evaluation	1.5	2.1	1.9
New Training Systems	7.2	9.0	10.0
Technology Appl. to Special Training Problems	2.8	2.8	3.6
Sub-Total (1)	16.4	18.8	22.1
Engineering Technology for Education and Training Systems (2)	10.8	9.7	10.5
Prototype Training Devices, Simulators and Computer Systems 6.4 funding (2)	9.1	13.7	14.9
Total	36.3	42.2	47.5

Source: ODDR&E, Human Resources, 21 May 1975

(1) This subtotal excludes funding for training device technology, prototype training devices and simulators, and other engineering projects related to the Human Resources Program.

(2) Includes the following program elements in the Human Resources TCP: 64715A, 64703N, 74227F, 63702N, W4308, and about $0.2 million in 6.5 funds. Excludes funding from the following program elements: 62763N, 63102F, 1193, 1958, 62709E.

TABLE 4-7

DoD BUDGET FOR RDT&E IN EDUCATION
AND TRAINING BY SERVICES AND AGENCIES, FY 1974-1976 ($ Millions)

		FY1974	FY1975	FY1976 FY 1976T
Army	6.1	0.4	0.7	0.7
	6.2	1.4	2.0	2.8
	6.3	3.7	2.7	3.6
	6.4	2.3	3.2	3.4
	6.5	-	-	-
	Total	7.8	8.6	10.5
Navy	6.1	0.5	0.5	0.6
	6.2	3.9	4.6	5.7
	6.3	5.3	5.6	6.7
	6.4	6.8	8.9	8.8
	6.5	-	-	-
	Total	16.5	19.6	21.8
Air Force	6.1	0.7	0.7	0.9
	6.2	2.0	3.0	3.5
	6.3	6.6	6.0	5.5
	6.4	-	1.6	2.7
	6.5	0.1	0.2	0.1
	Total	9.4	11.5	12.7
DARPA	6.1	-	0.4	0.4
	6.2	2.5	2.1	2.0
	Total	2.5	2.5	2.4
M&RA	6.5	0.1	0.1	0.1
	GRAND TOTAL	36.3	42.3	47.5

Source: ODDR&E, Human Resources, 21 May 1975

CATEGORIES USED IN EACH REPORT

MMTR	TCP
Recruit training	How to plan and evaluate educational/training program
Officer acquisition training	How to design education/ training media
Specialized skill training	How to evaluate trainees
Flight training	New generation educational/ training systems
Professional development training	Guidepost applications of technology to special educational/training problems
Training manpower	Design and engineering of training devices
Training organization and facilities	Prototype training devices
Training funding and costs	
Balanced use of training resources	
Reserve components training	

Because the various categories are not directly comparable, it is difficult to determine whether the allocation of funds for R&D is directed towards solving problems which may have the largest impact towards reducing expenditures for training. The question as to whether these two reports could be made more directly comparable, together with an evaluation of the presumed benefits (as well as problems) that might flow from doing so should be addressed directly.

The Technology Coordination Paper (TCP) on Human Resources (30 March 1973, p. 12) gives the highest priority to education and training as an important area for R&D.* However, the TCP shows no analytic effort which might relate the distribution of these funds to areas of greatest possible payoff, either with respect to various methods of training or to improved effectiveness of the operating and support forces.

4.4 CURRENT STATUS OF SKILL TRAINING

The methods used in current skill training vary almost as widely as the subject matter. The methods include conventional lecture and discussion and a very wide use of display material, charts, slides, movies, television, working models, simulations, and the like.

* The Technology Coordination Paper (TCP) on Human Resources (30 March 1973, p. 12) is presented in Appendix 4-2.

The development of lesson plans, instructional materials, and course tests probably equals the best current practise in the high schools. The training of the instructors, though not directly comparable to that offered at the best teachers' colleges, is probably superior to that offered to or required of college instructors. That is to say, the services conduct skill training in a thoroughly professional manner with a wide use of the most up-to-date educational practises.

A good example is the current emphasis on self-paced training which should be regarded as the implementation of R&D efforts supported by the services and non-defense agencies for more than 15 years. Self-paced training generally depends on a series of graded lesson plans, individualized training materials (often audio and/or video cassettes) and end-of-lesson tests before the trainee may proceed to the next unit or lesson. Instructors are usually available for assistance on an individual basis. The services have also started to use computer-aided and computer-managed instruction, and will do so increasingly.*

The direct effects of self-paced learning include a review of material taught in courses to ensure that their content is relevant to job performance rather than simply "nice-to-know"; and that the intermediate (lesson-to-lesson) and end results of training be specific and testable by objective means, in order to measure progress, establish qualification standards and evaluate the benefits of training. The indirect effects include pressure on the manpower system to improve its control over the number and types of jobs in the military system, when they have to be filled and refilled, the training and lead-time requirements for operating and maintaining new weapon and support systems, and training for career progression. An interesting improvement in the more efficient use of personnel comes from the need, already in practice, to assign and release personnel individually to their new jobs when they have completed their training, in a self-paced mode. This is in marked contrast to the conventional (or lock-step method) where release of the entire class to new duty stations is held up by the pace of slower learners.

Another important consequence of self-paced learning arises from the need to develop packets of training material, in a graded series, which can be used by individual students. Once this has been accomplished, it becomes feasible to consider and test the effectiveness of other potential improvements such as shifting the location of training from schools to operational bases. The use of audio-visual cassettes, and the additional use of the data processing capability already present in various military systems for training purposes (called "embedded training") are early examples of an anticipated shift in some training from the school to the operational base.** This would not only save travel and per diem costs on account of training, but would also

* A brief description of the services' use of computer-aided and computer-managed instruction is given in Appendix 4-3.

** Appendix 4-4 is an explanation of embedded training.

permit the use of less productive time of personnel on operating bases for purposes of training. However, the effectiveness as well as efficiency of training under such new circumstances remain to be established. (Baker 1974)

4.5 R&D ON SKILL TRAINING

To a very large extent, the military R&D programs must be credited with the foresight and support which have led to the present, generally progressive, level of technical knowledge about skill training. To a first approximation, the training methods and adjunct equipment used for skill training by the services are as advanced as those used anywhere else in formal training, at the high school and college levels, and in industry (to select comparable age groups and ranges in subject matter).* Considerable portions of the relevant research in the universities and industry have been supported by R&D funds for Human Resources and Information Processing. Significant portions of the research have been conducted within the human resources laboratories of the military services.

In earlier years, most of the R&D on training was basic and exploratory (6.1 and 6.2) in nature, with relatively little effort devoted to its implementation (6.3, 6.4). This was a clear conceptual gap because the products of R&D in training need advanced and engineering development, as well as operational test and evaluation, before they can be qualified for full operational use. This may not be obvious when the product consists of instructional methodologies, lesson plans and tests, perhaps because these exist primarily in the form of papers and reports. Advanced development and tests are, of course, inescapable requirements when the product consists of flight simulators and other mechanized types of training equipments. Fortunately, this gap is beginning to be closed and funding in support of training technology can now be found in all categories of RDT&E funds.

Yet it is characteristic of the effort of this DSB Task Force that the services have not been able to provide much detailed knowledge about the funding, content of programs, progress and accomplishments in these areas over the past few years.

Almost all of the R&D which has contributed to improving the effectiveness and/or efficiency of skill training is the result of side-by-side comparisons, i.e., observing differences, if any, between two methods of training. The differences between the two methods of training are measured by the amount of time required to achieve some level of mastery and/or the level of performance after a fixed amount of trials or time in training. This is a useful bit of information for an educational technologist, but

* Training Analysis and Evaluation Group (TAEG) Report No. 13-1, "Analysis of Commercial Contract Training" is a study of the feasibility of utilizing commercial sources to provide training for the Navy and Marine Corps in selected skill areas. A summary of this report is provided in Appendix 4-5.

it does not tell the manager of training whether he should institute the "better" method of training. To do so, the manager also needs to know whether the observed effects (superiority) are retained some reasonable amount of time after the completion of the experiment. He also wants to know whether the results apply only to the efficiency of the training procedure, which is important in its own right or, if we are more fortunate, to the quality of performance on-the-job. If the latter is true, then additional savings are possible in the number of men required on the job or in the amount and quality of the work that they can accomplish. Finally, the manager also wants to know something about the costs, if any, to develop the new training equipment and procedures needed before he can realize their anticipated benefits, and something about the cost of RDT&E to confirm the value of the new training technology.

Very little R&D in training technology has been evaluated by the criterion of utility in terms of cost-and-benefit. The failure to perform adequate cost-benefit analyses of RDT&E is hardly greater in training technology than in many other areas of the DoD technology base effort. However, this type of equality offers little comfort beyond that found in plans which the services have for embarking on such studies. A major change in the structure (if not the competence) of the R&D establishment in training is required before one can hold out any reasonable prospect for success in cost-benefit studies. The human resources laboratories and directorates of the services need a massive infusion of econometric talent not now found among their personnel. Needed almost as much are cost-analysis personnel, or at least the development of a capability to use and interpret the various types of cost and management data already being collected by the services. Since cost-benefit analysis of training is a new area of concern, it is likely that new types of cost and performance data will have to be collected to guide R&D on training.

It is only fair to point out that some efforts have been made to assess the cost and benefits of various methods of training. These would include, as examples, some studies conducted by HumRRO (summarized in a memo prepared by W. A. McClelland for this DSB Task Force, 22 Jan 1975)*, a cost savings analysis of maintenance training (Hdqtrs. 58th Combat Support Group, Luke AFB, 25 Apr 1974), and development of a methodology for estimating the cost of Air Force OJT (Samers, Dunham and Nordhouser, AFHRL-TR-74-34 July 1974). The most systematic conceptual effort in this area is being undertaken by RAND with support by DARPA (Human Resources). Doubtless, some studies may have been overlooked in this overview; failure of the services to bring them to our attention may be regarded as a contributing factor.**

* Appendix 4-6 is the W.A. McClelland memorandum of 22 January 1975.

** Attention is drawn to an Army reply which says that cost-effectiveness studies require information that is costly to come by and which can be analyzed only by 6.5 study and analysis funds. (Memo to Taylor from Barber 19 Feb 1975, enclosure 8.) See Appendix 4-7.

4.6 RDT&E AND THE OPERATIONAL APPLICATION OF RESULTS

Development of the technology base on training in general and on skill training in particular is performed by about ten major defense laboratories. These human resources laboratories, which perform this R&D, share the characteristics of most other defense laboratories engaged in the technology base effort. The performing personnel are civil servants, associated with a limited number of military personnel. Much of the work is done in-house, but with appreciable support by means of contracts. A significant part of the funds for improving training technology comes from the system commands and weapon systems program managers. Relatively small amounts are provided for Basic Research (6.1), or on a block-grant basis where the technical director of a laboratory can establish his own priorities for research, or on a sustaining basis to support R&D activities which require long time periods for their completion. The impact of pressures from the system managers, as major sources of funds for R&D on training , must favor application over research, and ad hoc efforts over sustaining ones. Although such pressures are not necessarily unproductive, they tend to limit opportunities for conceptual growth. The direct solution to this problem is to increase the amount of discretionary funds granted to each laboratory. Discretionary funds, such as Independent Laboratory Director's funds, may be in the 6.1 or 6.2 categories, and are granted to a laboratory without the assignment of specific tasks to be performed with those funds.

The availability of resources which may be used for research without the need to petition various external sources for support, permits the laboratory director to take prompt advantage of technical opportunities whenever they may arise. The possibility of making a significant technical improvement, and the need for funds to do so, cannot be tied conveniently into the annual budgetary and planning process unless some discretionary funds have already been provided for unforeseeable purposes. It is also clear that the laboratory director should be held accountable, after the fact, for the effective utilization of such a precious resource. Periodic reviews should be held for this purpose and they should include in-depth appraisals by independent consultants reporting to the director of laboratories. For the next three year period, it is recommended that 10 to 15 per cent of all 6.2 funds made available to the laboratories for training technology be assigned on a discretionary basis as technical opportunity funds. This amount should be derived by an equivalent reduction (distributed on a pro-rate basis) among the remaining programmed funds in training technology. The technical directors of the laboratories should be held accountable after the fact for the effective use of these funds. His performance should be evaluated by in-depth evaluations by independent consultants reporting to

the director of laboratories in each service. It is suggested that these consultants, with augmentation from other sources, may be drawn from the scientific advisory boards of each service and that DDR&E participate directly in these reviews.

The R&D establishment in training technology is, it may be said, twice removed from its ultimate customer: once from the training commands and once more from the operational commands. Even if it shares this type of separation from operations with most other areas of technology, its consequences deserve careful assessment. At least one consequence of the present arrangement is the opportunity it provides for conceptual growth somewhat removed from the more direct pressures of training and operating people. Not all would consider this to be a real advantage or an arrangement which has produced many favorable results.

All innovations in training, especially those which appear to promise marked improvements in quality and/or quantity of output, must be tested at various phases of their development. Separation of the R&D training community from the training commands has posed serious practical problems in availability of trainees for test and evaluation of new training procedures and equipments. According to the historical record, one research organization seems to have surmounted this difficulty especially well. The Human Resources Research Organization (HumRRO), when it operated as a FCRC organization, maintained divisions at five major training centers (for armor, recruit, infantry, air defense, and aviation training). Many of the major innovations in Army training can be traced to the opportunities afforded by the close relationship that existed between HumRRO and the several users of its products. There has been some co-location of research groups with the training commands in each of the services, but not nearly as closely nor for as sustained a period as by HumRRO and the Army. Some of the problems faced by the training laboratories at present can be traced to bureaucratic pressures to limit such close relationships. Clearly, institutional arrangements must be fostered by which personnel responsible for R&D on training can maintain close and continuing contact with the major training establishments and operating commands. Assuming that this requires co-location of R&D resources with those who use their products, there would remain a need for centralized direction over the various R&D efforts to improve training technology. Some of the laboratories are, in fact, located close to and, in some cases, have divisions located at major training bases. Nevertheless, assignment of research personnel as detachments to training centers should be much more widespread than is presently the case. In addition, more research personnel should be assigned on a liaison basis, perhaps on rotating tours, to major operational commands.

4.7 CONCLUSIONS

1. Specialized skill training concerns the individual training given after initial-entry training of both officer and enlisted personnel to provide new or higher levels of skills and knowledge required to match specific military job requirements. It includes only the initial specialized skill training, progression and functional skill training, of individual officer and enlisted service members in formal courses conducted by organizations whose predominant mission is training. This does not include on-the-job training (OJT), the training of recruits or crews, officer acquisition or flight training, or professional development education.

2. More than one and a quarter million service personnel are projected to enter such training during FY 1976 at an annual cost of more than $3.5 billion. More than 7000 courses are offered, with an average course length of 43.5 days (more than 6 weeks).

3. The annual budget for technology base RDT&E on education and training is about $28 million for FY 1975 and about $32 million has been requested for FY 1976. Although it has been estimated that about 40 per cent of these funds apply to R&D on specialized skill training, precise identification has not been possible. Training is not categorized in the same way in the Human Resources Technology Coordination Paper (TCP) and in the Military Manpower Training Reports. The "education and training" category of the TCP includes, but does not identify R&D on specialized skill training, which is, of course, one of the categories in the manpower report.

4. Virtually all methods of training are used by the services. There is a current emphasis on self-paced training; computer-aided instruction is increasing rapidly. These are important and effective technological innovations, but most instruction is still instructor-centered rather than student-centered. Only a limited review has been made herein of the content and relevance of information taught in these courses. Steps are being taken to improve the usefulness of knowledge taught and to ensure, by objective means, that the trainees have achieved the performance standards for completion.

5. These innovations in training are the result of R&D efforts that are regarded as relevant and effective, and which are still in various stages of development and evaluation. Current problems in skill training concern the evaluation and application of reasonably well-known results of previous and current R&D. This applies, generally, to such products as computer-managed instruction, the proper use of simulators, simplified course materials and manuals, and proceduralized job performance aids.

However, there is almost a complete absence of efforts to evaluate the benefits and cost of various methods of specialized skill training and to adjust accordingly the budgets for R&D on training technology. Although the R&D efforts on training are competent, per se, the failure to gather and analyze cost and performance data is a serious oversight that must be remedied.

4.8 RECOMMENDATIONS

1. Incorporate cost-benefit analyses of training procedures and equipments as a method of evaluating the R&D program on training technology in the Human Resources Technology Coordination Paper (TCP). To be meaningful, this procedure should obviously apply to all other major areas of this TCP.

2. Increase the assignment of R&D personnel, as detachments or divisions, to major specialized skill training bases. R&D personnel should also be assigned, on a liaison basis, to more operational commands.

3. Review the categories applicable to R&D on specialized skill training in the TCP and those on loads and costs in the Military Manpower Training Reports with a view to making them more comparable. The purpose to be served is to improve the ability to relate allocation of effort in various types of R&D on training technology to areas of major impact on the conduct of training.

4. Increase the number of manpower economists and cost analysts in the Training Technology R&D establishment.

5. Increase the amount of Exploratory Development (6.2) discretionary funds allocated to technical directors for their use in promoting and evaluating new ideas in specialized skill training R&D by 10 per cent to 15 per cent each year for a three-year trial period. This increase may be derived by a proportional reduction in other 6.2 funds for R&D on specialized skill training. Provide stringent review, with participation by ODDR&E, for purposes of accountability in the effective use of these funds.

REFERENCES (Chapter 4)

Baker, James D.
Application of tactical data systems for training (embedded training). U.S. Army Research Institute for the Behavioral and Social Sciences, Arlington, Va. 22209. Briefing to Defense Science Board, 17 December 1974.

Human Resources Technology Coordinating Paper
Department of Defense, ODDR&E (Environmental and Life Sciences), Washington, D. C. 20301. Revised version, Chapter III, Education and Training, draft undated (approximately July 1974).

McClelland, W. A.
Sample HumRRO Training research studies which demonstrated improved proficiency or decreased training costs or both, Human Resources Research Organization. Briefing material presented to the Defense Science Board Task Force on Training Technology, January 22, 1975.

Military Manpower Training Report for FY 1975
Department of Defense, March 1974

Military Manpower Training Report for FY 1976
Department of Defense, March 1975

Report of Secretary of Defense James R. Schlesinger to the Congress on the FY 1976 and transition budgets, February 5, 1975.

Samers, Bernard N., Dunham, Alan D., and Nordhouser, Fred
The development of a methodology for estimating the cost of Air Force on-the-job training. Air Force Systems Command, Brooks Air Force Base, Texas 78235. AFHRL-TR-74-34, July 1974.

____ A cost savings analysis of the MISD approach to maintenance training. Headquarters 58th Combat Support Group, Luke Air Force Base, Arizona 85309, 25 April 1974.

CHAPTER 5

OFFICER ACQUISITION TRAINING AND PROFESSIONAL DEVELOPMENT EDUCATION*

5.1 GENERAL DESCRIPTION**

This chapter deals with two areas of military manpower training: officer acquisition training (OAT) and professional development education (PDE). Officer acquisition training leads to a commission in one or another of the services. Both career and non-career junior officer are acquired through OAT, and both active duty and reserve components get their new officers through this system. Less than half of all OAT is done in military institutions; a sizable proportion, i.e. about 60 per cent, takes place in colleges and universities; note that two-thirds of all newly commissioned officers come up through civilian colleges and universities, i.e. ROTC. Table 5-1 shows the three principal sources of new officers: academies, ROTC, and officer candidate schools, by service in terms of the FY 1976 output of just over 17,000 second lieutenants and ensigns. Table 5-2 list the principal facilities at which OAT takes place.

Professional development education provides training and education at different stages of military careers, primarily to officers but with some senior NCO participation. Among the areas treated in PDE are military science, engineering, and management. Both military and civilian institutions are used to provide PDE. Table 5-3 is a list of the major PDE sites; it does not include the civilian institutions at which such education is provided.

The number of military personnel participating in PDE is large. About 14,000 men and women will be students in one or another PDE program during FY 1976. There are four levels of PDE: basic, advanced, senior, and enlisted leadership training.

5.2 COST OF OAT AND PDE

Of the estimated $6.8 billion military training budget for FY 1976, only about $358 million (5.2 per cent) will be spent on officer acquisition training and $520 million (7.7 per cent) on professional development education. Tables 5-4 and 5-5 show expenditures in these areas by service. Although the overall cost of PDE is greater than that for OAT, fewer students are involved in the former than the latter.

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*H. Wallace Sinaiko

**This section is a brief overview. For a more detailed description of courses, training loads, and costs, see Appendix 5-1.

TABLE 5-1

OFFICER ACQUISITION TRAINING:

SOURCE* BY SERVICE, FY 1976 OUTPUT**

	Academies	Per Cent	**** ROTC	Per Cent	OCS	Per Cent	Total	Per Cent
Army	875	12.5	5,095	73.3	985	14.2	6,955	100
Navy	815	24.2	1,480	43.8	1,078	32.0	3,373	100
Air Force	935	16.0	3,575	61.4	1,316	22.6	5,826	100
Marine Corps	***		***		966		966	***
DoD TOTAL	2,625	17.4	10,150	67.2	4,345	28.7	17,120	

* The Sources shown produce most junior officers; however, other programs provide small numbers of officers.

** All tables based on data from Military Manpower Training Report FY 1976

*** Naval Reserve Officer Training Corps is, in a sense, a misnomer, since 75 per cent of all new ensigns get regular Navy Commissions.

**** Some Naval Academy graduates and some naval ROTC graduates receive commissions in the Marine Corps.

TABLE 5-2

OFFICER ACQUISITION TRAINING:

FACILITIES AND LOCATIONS

Army

Military Academy, West Point, N.Y.
USMA Preparatory School, Fort Belvoir, Va.
Officer Candidate School, Fort Benning, Ga.

Navy

Naval Academy, Annapolis, Md.
USNA Preparatory School, Newport, R.I.
Education and Training Center, Newport, R.I.
Aviation Schools Command, Pensacola, Fla.

Marine Corps

Development and Education Command, Quantico, Va.

Air Force

Air Force Academy, Colorado Springs, Colo.
USAFA Preparatory School, Colorado Springs, Colo.
Officer Training School, Lackland Air Force Base, Texas

TABLE 5-3

PROFESSIONAL DEVELOPMENT EDUCATION:

FACILITIES AND LOCATIONS

Army

War College, Carlisle Barracks, Pa.
Command and General Staff College, Ft. Leavenworth, Kan.
Sergeants Major Academy, Ft. Bliss, Tex.

Navy

War College, Newport, R.I.
Postgraduate School, Monterey, Cal.

Marine Corps

Development and Education Command, Quantico, Va.

Air Force

Air University Organizations:
- Maxwell Air Force Base, Ala.
- Gunter Air Force Base, Ala.
- Wright-Patterson Air Force Base, Oh.

Health Professionals Education Organizations:
- Brooks Air Force Base, Tex.
- Keesler Air Force Base, Miss.
- Lackland Air Force Base, Tex.
- Travis Air Force Base, Cal.

Joint Schools

National War College, Ft. McNair, D. C.
Industrial College of the Armed Forces, Ft. McNair, D. C.
Defense Resources Management Education Center, Monterey, Cal.
Defense Systems Management School, Ft. Belvoir, Va.
Armed Forces Staff School, Norfolk, Va.

Note: The above list excludes civilian institutions at which training may be conducted.

TABLE 5-4

OFFICER ACQUISITION TRAINING:

COST BY SERVICE, FY 1976
($ Millions)

Army	$112.1
Navy	108.3*
USAF	119.6
USMC	17.7*
DoD TOTAL	$357.7

*Some Navy cost includes training Marine Corps Officers.

TABLE 5-5

PROFESSIONAL DEVELOPMENT EDUCATION:

COST BY SERVICE, FY 1976
($ Millions)

Army	$144.0
Navy	104.1
Air Force	166.6
USMC	28.0
DoD TOTAL	$442.7

The main reason for this apparent anomaly is that much higher pay and allowances are involved for PDE, primarily because it is the more senior career officers and NCOs who participate in the program. On a per capita basis. DoD will spend from less than $10,000, at the Officer Candidate schools, to about $100,000, at the service academies, for each newly commissioned officer in FY 1976*; about $37,000 will be allocated to support each PDE participant. In contrast, recruit training costs about $3200 per man. These are very rough estimates, of course, but they do provide an indication of relative investments in the three types of training. We wish to emphasize that the small proportions of DoD's training budget should not be taken to mean that OAT and PDE are less significant than other categories of military training. Indeed, the extent to which our Armed Forces can provide effective combat leadership, effective resource allocation, and insightful planning will largely be determined by their officer training and education programs.

5.3 TRAINING TECHNOLOGY IN OAT AND PDE

Both areas tend to be highly traditional in their pedagogic approaches. Most pre-commissioning training is done in college or college-like settings, i.e. ROTC and service academies, respectively. Approaches to training tend to be traditional--lectures, seminars, reading, and the like. This is particularly true in the oldest of the service academies, the U.S. Military Academy (USMA) at West Point, which had as one of its earliest superintendents Major Sylvanus Thayer. Starting in 1817, the Thayer System". . . incorporated many of the teaching philosophies and practices that prevail to this day..." i.e. small classes, daily recitations for each cadet, a carefully prescribed curriculum, and a set of rules and prohibitions governing cadets' behavior. (See References 1 and 2.) We cite this to underscore the traditional character of some officer commissioning programs.

On the other hand, certain OAT programs are models of the latest technologies that can be acquired. The Air Force Academy (AFA) is an outstanding example of this. That institution has a Directorate of Instructional Technology, for example, that could only produce reactions of envy and awe from civilian higher education authorities. ** AFA cadets are the beneficiaries of a remarkably wide range of hardware applications, from a planetarium (in the astronautics course) to instant replay TV (used in physical education) to a smoke tunnel (in aero engineering), and many more. Another example of technology applied to the educational process is closed circuit, color TV to permit previewing chemistry experimental procedures. This approach is said to prevent the wastage of materials normally lost during false starts by students; it is also supposed to be time-saving in that students can observe skilled instructors directly without going through a trial-and-error phase. (We wonder, however, whether false starts and trial-

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* These are average "per-man, per year" figures.

** Appendix 5-2 provides a description of the Directorate of Instructional Technology.

and-error aren't necessary to the learning process.) Sub-departments of the directorate seem to be as sophisticated in their approaches as the field will permit. The only negative comments some of our panelists could make were that "It can't be that good." There is some concern that the AFA is much more interested in action than it is in pausing to assess the efficacy of its system. But this may be a necessary price to pay for progress. If one had to find fault with AFA's exploitation of training technology, it would lie in this absence of evidence of effectiveness.

The Naval Academy (USNA) has installed computer-aided instructional facilities with a flair not usually characteristic of such a known tradition-bound institution. There are now about 180 remote computer terminals installed, and over 100 courses (of the approximately 500 offered) use the computer system to some degree. In its early developmental period, the Naval Academy system cost between $12-$20 per "connect hour"; the cost has been reduced to about $3/hour. It is said that all midshipmen and about 75 per cent of the faculty use the computer system to some extent. Major payoffs are said to be in faculty reduction and curriculum enrichment. We were told that fewer instructors are now employed, but no data were provided in support of this claim. Enrichment is said to come from "midshipmen's being exposed to more material and under more realistic circumstance through computer aided design, modelling, copies data reduction and flexible data inquiry". (Reference 3)

The Office of Naval Research provided the initial funding of about $50,000 for the R&D that lead to the present computer-aided instructional system at the Naval Academy. The direct involvement of R&D decreased to zero over a five-year span in direct proportion to the number of new operational users of the CAI system; and this is as it should be. Interestingly, representatives of the professional staff at USNA denied any contributions by R&D to the computer system; we know, however, of the major role played by the Office of Naval Research and others in getting instructional computers into the Naval Academy. (One of our more insightful briefers had an explanation: the more successful an R&D contribution, the less possible it becomes to trace particular R&D inputs. Put more succinctly, "If it works, they all want to take credit.")

The USNA has been concerned with assessment of its system, and careful planning and some data collection have gone on. (See Reference 3 for a complete account of these activities.)* What is important, as is true at the AFA, is that there is a major commitment to this form of training technology and that midshipmen are the beneficiaries in many substantive areas.

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* Excerpts from the Final Report on the Naval Academy's CAI Project is given in Appendix 5-3.

The service academies teach computer science, and they appear to be on a par with civilian universities in this area. The Air Force Academy requires a basic computer science course of all of its cadets. The time-shared system at that institution is heavily used: 6000 hours per month are regularly logged on the sixty remote terminals. (This is an average of 1.5 hours per cadet each month.) We had little evidence of the Military Academy's specific involvement with computer aided instruction or with training technology in general, except that since the early 1970's cadets no longer are required to learn the slide rule; instead, they all take a basic computer science course.

In the officer candidate schools, which exist to handle surge problems and which sometimes supply up to 45 per cent of the services' needs for O-1's (Second Lieutenants and Ensigns), there appears to be virtually no advanced training technology beyond an occasional simulator-demonstrator (e.g. Navy's damage control simulation device at Newport). The ROTC units of the services--producers of the largest number of entry-level officers--are co-located in universities and do not incorporate much, if any, advanced technology in their curricula. Attrition during training for the three main sources of junior officers--academies, ROTC, and OCS--are, respectively: 45 per cent, 68 per cent, and 21 per cent. (These are averaged, and they do not reflect differences among the separate services.)

In the area of PDE (professional development education) we learned about very little use of anything identifiable as training technology. Perhaps this is because PDE programs are perceived as "educational" in the broadest sense, i.e. aiming to produce intellectual and technical breadth that cannot be tied to hardware technology. It is apparent, however, that most PDE programs are tradition-bound to the extent that they could benefit from methods permitting, at the least, individualized progress. The Army is in the process of changing its officer basic and advanced courses,* giving much greater emphasis to equipment and other hands-on training. Such training has become oriented toward performance. In addition, diagnostic testing has been introduced, along with better methods for instructor evaluation. All of these developments are said to have been the result of R&D support.

The Air Force's Institute of Technology (AFIT) does include a small cadre of "educational technology experts," but their number may be too small to have an impact. The AFIT installation includes computers, closed circuit TV, "learning centers," mock-ups, and "telelecture." (The latter provides a means for lecturers in one location to address remote classes via telephone and speaker systems.) The Air University had invested in 50 Execuport units as terminals for its computer based instructional system; among others, courses in systems analysis modeling, international relations, and logistics management are offered. Currently under study at the Air University are the relative merits of the PLATO IV and TICCIT systems for extensive application to AV courses. DSB panel members were concerned that the Air University

* An example is the Transportation School for Advanced Officer Training, which uses a small-group, problem-solving approach - the so-called Indiana Plan.

staff was apparently unaware of other assessments of these large systems; nor, apparently, had the question been asked of whether <u>either</u> PLATO IV or TICCIT was appropriate. Finally, there was no evidence of any interface between the R&D community and Air University officers, despite the high potential costs of systems like PLATO IV and TICCIT. We were told of the application of "compressed speech" at Air University; according to some academically-based researchers, however, this technology has been generally disappointing.

In some areas, non-resident instruction (i.e. learning by correspondence courses) continues to be a major training approach. We learned that there is in progress an expansion of non-resident instruction (e.g., Army's NCO educational system), although the advantages of such an approach are not clear. (There is evidence from civilian and military correspondence courses that non-completion rates tend to be very high, e.g. 85 per cent or more.) The heavy demand for verbal skills--reading course materials, writing assignments and taking tests--seems to fly in the face of research-based evidence that many military tasks are not essentially verbal; moreover, in the case of enlisted personnel who possess limited verbal fluency and have little need for such ability, the demands of correspondence courses may unnecessarily penalize otherwise competent men.

With no discernible exception, all pre-commissioning students proceed through training at a fixed rate and in well-defined set curricula. In post-commissioning training, e.g. the Army's Officer Basic and Advanced Courses, there is virtually no management flexibility to provide for different learning rates of proficiency levels. There is little evidence that any officer programs anticipate and train for problems likely to arise in five to ten years. The management of officer careers--which is broadly within the realm of training technology--is generally archaic by comparison with other (i.e. industrial) institutions. It did not seem likely that any of the services' career systems could identify outstanding young officers and move them ahead at a rapid pace. Whatever the reasons for maintaining a lock-step system, there must be attendant and avoidable costs brought about by early voluntary removals from active service of some highly capable younger men and women due to their frustration with "the system."

Professional development education is largely justified as a means of upgrading and broadening the skills of career officers and NCOs. Some military officers typically spend 15-25 per cent of their careers in some sort of training or educational activity. On the other hand, civilian professionals, e.g. doctors or engineers or professors, do not commit nearly as much of <u>their</u> professional careers to post-graduate school. We do not question the need for maintaining professional skills, or for learning new ones, but we suggest that there may be more effective ways to do this among military personnel For example, the senior service colleges--National War College, Army War College, etc.--are geared to a one-year cycle. This appears to be tied to moving

schedules, family disruption, and so on. It is certainly likely that very short courses (e.g. one-two weeks) could be provided to substitute for some of the time-costly senior courses. In any case, we think serious comparative study of military and civilian professional practices in the PDE area would be useful.

The service academies are very expensive compared with other ways to develop young officers. One argument favoring the academies is that they provide a "shared experience" which results in a unique esprit de corps that is essential to leadership and teamwork on the battlefield. The facts show that only 10-15 per cent of all officers are academy graduates and that many of the remainder serve with distinction. This suggests that the value of "shared experience" may be more a myth than a necessity. In any case, the R&D community might be called upon to develop and test alternative ways of providing the "shared experience" that is said to come only from the four-year academies.

A word of concern: There is little doubt that training technologies are being applied on a large and expensive scale, particularly in the Air Force and Naval Academies. Task Force members felt that few universities could claim such extensive installations. But conspicuously absent from the presentations was any consideration of "what to teach" instead of "how to teach." In response to our questions, we heard little evidence supporting the claim that competent junior officers were being produced in OAT, or that the educational experiences provided to more senior officers and NCOs were beneficial. There is a likelihood that "training technology" is being equated with "media" by the services' agencies charged with implementing such technology. We felt that the important problem of dealing with individual differences among officer-students was not receiving enough attention. There is a danger, as has been true in the public education sector, that fads and gimmickry will be adopted at the expense of proven technology. The recent interest in "multi-media" is an example of this. Multi-media devices are dangerously seductive; their use can lead the naive observer to the false assumption that, having been exposed to sound and light and hands-on apparatus, all students have learned. The panel urges continued assessment of all actual training technology applications to provide data and guidelines for proposed future utilization.

In conclusion, we want to underscore the importance of what an Air Force briefer aptly called "the most important variable". The teacher is of primary importance, and he is likely to remain so into the indefinite future. Better officer training and professional education can be brought about in many ways, e.g. by sensible career management of teachers, good preparation in the art of teaching, rewards provided for outstanding teachers, and by providing hardware that serves to unburden and enhance the role of the instructor. The adoption of new training technology should be based on its effectiveness and cost; most important, it should support the teacher, not supplant him.

5.4 R&D IN TRAINING TECHNOLOGY FOR OFFICER ACQUISITION TRAINING AND PROFESSIONAL DEVELOPMENT EDUCATION

With the possible exception of recruit training, there is probably less identifiable R&D in the officer training and education areas than in any other training category. This is partly because of the largely traditional methods used in the officer training programs, i.e. lecture, study, discussion; and partly because these programs are seen as sacrosanct. That is to say, the very people who would have to decide that officer training and education are deficient and in need of R&D support are themselves successful products of these systems. Put another way, "It was good enough for me and it will be good enough for my successors." Nevertheless, there have been some known allocations of R&D resources to the officer training area, and we review selected examples of them here, by service-sponsorship.

Army

The Army Research Institute for the Behavioral and Social Sciences (ARI) has successfully engaged in a number of studies dealing with officer acquisition. The first example, "ROTC, leadership development processes," was begun in 1969 and is scheduled to be completed next year. The work has been concerned with developing performance-based techniques for assessing leadership skills. Some of the products of the first six years of this work are: (1) a computer-assisted, performance-based assessment system that is used in advanced summer ROTC camp; and (2) a "field problems" test for assessing exercise performance.

Another ARI project, "performance based leadership development processes," is aimed at the identification of leadership potential among officer candidates. However, most of this work is psychometrically rather than technologically oriented. A third ARI project is a "leadership training program evaluation" for the senior ROTC course. The basic data source has been a survey of ROTC units. Outputs of this work are expected to result in new training performance criteria, measures of differential leadership, and the like.

Benefits of Army research in officer acquisition training are said to be "improvements in the quality of the product" rather than savings in training costs. We do not have, however, any quantitative (or other) evidence of improved junior officer performance resulting from the research program described above.

During the past two decades a great deal of research on Army officer training was accomplished by the Human Resources Research Organization (HumRRO). Varying uses of technology were made in this work. A few examples follow. (For a more complete elaboration, see Reference 4.) They are interesting because each case resulted in an action by the Army, i.e. research results led to changes in the ways officers were trained.

An early HumRRO study, OFFTRAIN, dealt with improving leadership skills of junior officers. Sound films became the presentation medium of leadership problem situations. Careful evaluation of the OFFTRAIN course, i.e. comparing its effects vs. conventional training, showed ". . . great improvement in the quality of solutions to leadership problems, and (the students) were better able to evaluate leadership in others . . ." In 1970 it was noted that certain OFFTRAIN materials were being used to train Vietnamese Army officers in Vietnam. (One wonders whether the obvious culture-bound nature of leadership had been considered; the HumRRO report does not say.) Other modifications of junior officer leadership training followed, and OFFTRAIN materials were adopted for use by ROTC, aviation warrant officer candidates, the Army Security Agency, the Army Quartermaster OCS, and the Armor OCS; an adaptation is being used in WAC officer training.

A different and highly specialized type of training was devised by HumRRO to prepare Army officers for a unique type of assignment: work in a non-American culture as a military assistance advisor. It became apparent from research on the experiences of Army advisors that sensitivity to one's own and other cultures was a critical element in successful performance. HumRRO foreign area specialists developed a "simulated inter-cultural encounter" technique in which officer-students participated in life-like role-playing situations, with foreign nationals acting as counterpart officers. The technique involves videotaping these encounters and then excerpting certain critical aspects for incorporation into the military assistance training program. The use of this method has made possible the teaching of a very complex concept, namely the influence of one's own culture on one's perceptions of the ideas, feelings, and behavior of others. Since the HumRRO work was completed for the Army, it has been adapted by the Navy for its amphibious schools in Coronado, California, and Little Creek, Virginia (both sites where naval advisors are trained). (The Air Forces' Human Resources Laboratory at Wright Patterson Air Force Base during the late 1960's also developed a similar technique; we do not know whether it saw any operational application.) We have also heard that the Peace Corps has made use of the technique.

Navy

Responses to our queries have indicated very little R&D support for training technology in the officer acquisition and professional development areas. The Navy Personnel Research and Development Center (NPRDC) reported that, ". . . in contrast to an area like individual specialized skill training, R&D efforts have been sporadic and usually of relatively modest funding." Reasons for such a situation were several. First, there is no officer training activity near NPRDC, and ". . . Propinquity of personnel R&D organizations to operational personnel organizations has a driving effect on the R&D organization's efforts." Secondly, there have been few expressions of sponsor interest in training R&D for the officer areas. Thirdly, the much larger number of enlisted personnel has forced training R&D to be concentrated at that level.

Fourthly, Navy Training Technology R&D has been nearly exclusively directed at skill training rather than education.

However, some Training Technology R&D has been done. We have earlier (section 5.3) described the computer aided instructional system at the Naval Academy as an outstanding contribution by the R&D community. Other examples include the development of programmed instructional material to teach relative motion to naval officer candidates. This work is said to have individualized the training process, and it has been adopted by some ROTC units as well as by the OCS.

The Naval Postgraduate School (NPS) is the principal Navy in-house institution devoted to graduate education. A formal "instructional systems development procedure" is used to establish new curriculum elements at NPS, but there is no R&D support for these efforts. There was an in-house study at NPS in 1968 which led to the establishment of a closed circuit TV (CCTV) system for teaching computer programming; this innovation has resulted in an impressive reduction of six professorial man-years each year since implementation. In addition, a CCTV "dial retrieval system" has been in use at NPS since 1972. This has worked toward individualizing instruction by permitting officer-students to call up video taped programs as needed. At present, NPS has no funding for R&D in instructional technology, but all academic departments work toward the incorporation of multi-media devices into their curricula. There is under consideration for adoption at NPS of a "personalized system of instruction", which is intended to support a recently established (1974) Office of Continuing education. It is hoped that the new system will permit students to begin courses at any time; it will also shorten the time required to take prerequisites for advanced courses. A half-time Dean of Educational Development at NPS is charged with keeping up with outside developments in educational technology, but there is no other funding available for this activity.

The Naval War College is the senior naval officer education facility. With the exception of a Center for War Gaming, which provides computer-based simulation, no other educational technology was reported as being employed at the War College. There is to be installed a new gaming simulation system, and the development of highly sophisticated software is an R&D responsibility. The installation has been held up because of competing R&D priorities. As a result, according to written submissions to the DSB Task Force, the War College's ability to perform its assigned gaming tasks has been seriously hindered. The institution had its curriculum, teaching methodology, and overall style drastically revised in 1972.* The main methods of instruction now include case-study seminars and lectures, both accompanied by heavy student-reading requirements.

*Appendix 5-4 provides a description of the revisions of the Naval War College curriculum.

Marines

The Marine Corps cites a recent R&D effort at the Navy Personnal Research and Development Center (NPRDC) in support of USMC officer acquisition and professional development programs. The study, titled "Application of Innovative Training Support Systems (1975-1980)," was completed in May 1974 and cost $125,000. In the words of the USMC's submission to the DSB Task Force, "The final report reflects an examination of requirements for further Marine Corps audiovisual requirements. In this respect, it will serve to provide guidance to field commanders in identifying requirements for audiovisual equipment." We have not seen the NPRDC report, but apparently it was a paper exercise limited to examining methods of presentation. Our earlier concerns (see Section 8.3) apply here, too: attention has been on "how to teach" at the expense of "what to teach." Also, we would like to know if there are perceived deficiencies in the Marines' OAT and PDE programs, and, if so, how do they relate to training support systems. Incidentally, the Marines do not have a group with responsibility for keeping abreast of educational and training technology. Rather, this duty is assigned as a collateral task to a civilian in the Education Center, Marine Corps Development and Education Command.

Air Force

The Air Force Academy, as has been mentioned (Section 5.3), has made major commitments in Training Technology R&D. Nearly all research in support of instructional programs is done by the individual academic departments. Assistance is provided by the Academy's Directorate of Instructional Technology. There is a great deal of emphasis on instructional media, e.g films, slides, CCTV, and viewgraphs. Some examples of departmental research on instructional technology follow.

The English faculty invested a small amount in casette tapes for assisting students with "mechanical writing" problems; it thus freed instructors to deal with nonrepetitive problems. Foreign language departments use language laboratories to improve listening comprehension and speech. Electrical Engineering utilizes standard test equipment and breadboards to teach construction of circuits. The Department of Economics, Geography, and Management has a self-paced introductory management course which may be completed in as little as 12 weeks instead of the full semester normally required. An interesting practice by the Geography Faculty has been the videotaping of lectures by distinguished geographers invited to address Air Force Academy students; such tapes become part of the archives, and they are subsequently used in many courses.

At the heart of the AFA's use of educational technology is its Directorate of Instructional Technology mentioned earlier. The group has about 80 people assigned full-time to "communication media" activities.* The Directorate is also charged with keeping up with new developments in educational technology; staff members participate in professional activities outside the Academy (e.g. National Association of Educational Broadcasters). The Directorate closely monitors in-house Air Force R&D, including the Air Training Command's computer-assisted instruction experiments, the Air Force Human Resources Laboratory's advanced instructional system, and the Air University's Learning Center.

The Air Force reports a modest number of projects in training technology under Air University sponsorship; all are in-house activities, and all are aimed at improved instructor training. An example is a project on "micro-teaching" with video cassettes. The purpose of the study was to test concepts that had originated at the Brigham Young University and the University of Wisconsin. Student teacher competency and the impact of "micro-teaching" on particular courses, is to be measured. This work is scheduled for completion in May 1975.

The in-house R&D activity for education and training is the Air Force Human Resources Laboratory (AFHRL), an arm of the Air Force Systems Command. With regard to the two areas of officer acquisition training and professional development education, AFHRL " does not currently have mission responsibility, technical capability, nor resources in either of these areas." However, a great deal of research on selection for the Air Force Academy was done by AFHRL during 1959-1968; some similar studies were done on Officer Training School students. Work was also done on motivation for flying training among Air Force ROTC students. There is a long literature of AFHRL technical reports dealing with the Air Force Academy, AFROTC, Air Force Institute of Technology, Officer Training School (OCS), and professional schools. However, none of the titles we have seen deals with training per se. In 1971, a systems analysis was completed dealing with "procedures to insure that the professional development education system would be maximally responsive to the evolving needs of the Air Force. . ." We have also seen reference to a "broad study (of) alternative continuing education systems. . ."

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* Perhaps this early investment in effective human communications is why the Air Force seems to outperform the other services in the quality of its briefings--and, closer to home, in its responses to queries by this DSB Task Force.

5.5 MANAGEMENT ISSUES: R&D REQUIREMENTS AND PRIORITIES

In querying the services for material to go into this chapter comments were invited in several areas: R&D requirements and priorities, evaluating officer training and educational programs, and the "training of trainers." This section summarizes the services' responses to these and related matters.

1. Army -- In the Army's Senior ROTC program there is close liaison between TRADOC's Deputy Chief of Staff, ROTC, and the Army Research Institute for the Bahavioral and Social Sciences (ARI). Work at ARI, described elsewhere in this chapter, is aimed at improving cadet assessment, evaluating the ROTC program of instruction, developing "management/leadership simulations," and the like. Contractors working for ARI have recently developed "assessment/training" simulations for the Senior ROTC program. Army Regulation AR-70-8 provides for the generation Human Resources Needs (HRN's), which constitute a major source of R&D program support in the Army. ARI mentions several ways it goes about promoting interchange between trainers, e.g. TRADOC, and R&D personnel periodic meetings (e.g. Human Factore R&D Conference), special standing committees, etc. An example of the latter is the ROTC Curriculum Development Steering Group, with members from ARI, ROTC regions, and TRADOC's DCS-ROTC.

Priority instructional problems facing officer training managers are several: Army ROTC has a continuing need to provide effective military science preparation in the larger context of a university or college environment. Because of recent changes brought about by the Officers' Personnel Management System, ROTC is being required to carry a greater load of branch military subjects which have previously been taught in the post-commissioning officer basic course.

At the Army's Infantry School no research support for OCS has been requested for FY 1975 and FY 1976. Some research proposals by ARI have been approved without concurrence by the Infantry School; this has created problems because resources of the school would be required in conducting the research. Responses from the Military Academy indicate that there are no priority instructional problems.

2. Navy -- The Navy's ROTC program managers say, "No research requirements have been identified in recent years for NROTC." At the Navy's Postgraduate School (NPS) there are two offices which facilitate the interchange between PDE managers and the R&D community, namely, the Office of the Dean of Research and the Office of the Dean of Educational Development. (However, the latter is a half-time position with no budget for R&D.)

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"In addition, each department chairman and faculty member is free to exchange information/requirements with the R&D community." Priority instructional problems at NPS are said to be, ". . . the development of more efficient ways to deliver graduate education in order to: a) shorten the time in fully funded programs, and b) provide technological updates in subspecialty fields.." There is also a need for the development of "multi-media materials to support . . . (these programs). . ." A need for "high quality animated videotapes in highly technical areas has been expressed verbally to Naval Instructional Technology Development Center; however, they do not presently have the capability to prepare such tapes."

3. Air Force -- The Air Force Academy's Directorate of Instructional Technology reports that it maintains a lively interchange with the Air Force training and education community (e.g. Air Training Command, Aerospace Audiovisual Services, Air University's Learning Center), and the AFHRL. The Academy's reply to our query about relations with trainers and R&D personnel bears repeating in part:

> "Academic managers in addition to exchanging ideas with professional military school managers (Squadron Officer School, Command and Staff College, and Air War College) also keep in touch with their civilian university counterparts. Practically all instructors are members of professional academic organizations. Faculty members are encouraged to attend professional meetings, publish research papers, and speak at professional gatherings....
>
> "This continuous process of exchange with various sectors of the research community has served the Air Force Academy well....
>
> "Thus, while Academy managers do not 'seek help' from the research community per se, a continuous exchange process exists which insures that the latest state of the art advances are brought to the attention of all Academy managers. As such, the R&D community has been very responsive to the Academy program."

While the Air Force reports no "true priority instructional problems," it submitted several ideas for innovative training approaches that, given support, the AFA staff would like to institute: a) bring in an authority on training research to offer a one week summer seminar on late developments in training

technology, b) assign an educational technology specialist to each academic department to help implement new techniques; c) permanently install computer terminals, video cassette TV, and microfiche readers in all classrooms; d) provide more opportunity for and emphasis on cadet summer research in other Air Force activities (e.g. Air Force Weapons Laboratory).

In the area of professional development education for Air Force officers, we were told of several priority instructional problems. One has to do with designing an effective curriculum that can be useful in the near term when the subject matter is in a state of constant change. Examples are perceptions of national security, changes in contemporary social values, and shifting national economic conditions. Another issue is the need for identifying and dealing with individual student needs. Examples of the latter may include academic weakness (e.g. mathematics); these are handled with remedial elective courses, but such instruction at present has to be terminated by calendar dates instead of student attainment. A third problem, in a sense the reverse of the latter, is the difficulty of recognizing prior expertise and knowledge in individual students. This sometimes results in duplication of training for officers who attend more than one school. (The latter is obviously more a management problem than one of technology, but it bears mention here.)

AFHRL reports good utilization of its services by the Air University, the AFA, and ROTC managers. However, the actual number of requests for assistance has been small. AFHRL says, "This is fortunate, since AFHRL resources have been limited. We have met all but one or two requirements in a timely and satisfactory manner. One request has been turned back for lack of resources (RPR 74-28), but with an offer to provide the data base required for analysis by Air University personnel."

5.6 EVALUATING OFFICER TRAINING AND EDUCATIONAL PROGRAMS: BARRIERS TO INNOVATION

1. Army -- We asked how the services evaluated OAT and PDE effectiveness and whether there were barriers to innovation in these areas. The Army's TRADOC oversees a continuing assessment of ROTC graduates' ". . . performance at Advanced Camp, Officer Basic Course (OBC) peer-rating leadership measures, OBC course performance and evaluation of first-tour duty assignments. These evaluations seek to compare ROTC curricula in terms of graduate performance effectiveness. Performance shortcomings are analyzed and corrected by changing the ROTC curriculum, both on the campus and at camp." TRADOC also has established a formal ROTC Curriculum Development Steering Group to monitor all proposals for curriculum change, etc. Barriers to instructional innovation are seen as stemming from personnel reductions, which limit ROTC staff activity to

maintaining the status quo, and reductions in funds that are needed to buy new instructional technology.

Responses from the Army Command and General Staff College were terse, straightforward, and refreshingly candid: educational programs are evaluated by ". . . faculty survey, personal inspection, and daily observation . . ." Changes in the program are assessed "by observation and reflection." Barriers to innovation at the C&GS College were seen as: a) ingrained notions of the way instruction should be presented, b) lack of funds, c) lack of time for workshops, and d) no perceived reward for taking chances. The last is a frequently heard comment that is unfortunately not limited to educational innovation.

The Army Infantry School has an elaborate and well-defined system of evaluation which includes these steps: a) an Evaluation Division develops policies and procedures, b) the Division administers tests for each course, c) an item analysis is performed, d) questionnaires are administered to students and graduates to "evaluate quality and effectiveness of instruction...", and e) a Training Effectiveness Branch conducts "in-depth studies of the educational process of selected programs...". The Infantry School reported that the main barriers to educational innovation were lack of funds and high staff and faculty turnover, e.g., ". . . Few innovators can follow a project through to completion before being reassigned. . . . There is little opportunity now for a second innovator to obtain and build on the ideas and practices of the first. . . ."

ARI had a similar response concerning barriers to innovation: "(They are due to) too-frequent change of military personnel responsible for program innovations. Hopefully Officer Personnel Management System can credit such military service toward career progress. The Air Force has possibly done better in this regard." In addition, ARI cited two barriers to innovation in officer training:

a) Time constraints, brought about by overload of content along with training time reductions.

b) Policy and financial support fluctuations, e.g. "quick-fix" attitudes and "drastic cutbacks which prevent payoff in promising programs. . . ." In addition, ARI argued, ...

"Productive research experimentation is far more likely to result if it is managed and supported as such, rather than being handled as an additional drain on operational

> training resources. Emphasis on immediate payoffs has been encountered in Army leadership training research, at times to the detriment of a sound R&D program. Emphasis on training "hard skills" only may conceivably lead to producing officers who master a number of specific techniques but may lack the skill to utilize them appropriately in a given leadership situation. Development of the judgmental and interpersonal aspects of leadership is likely to be enhanced by training experiences which simulate the situational requirements. Despite the scientific work on realistic assessment processes beginning with the 6.2 program of ARI in the mid-sixties and continuing with the 6.3 work at the Assessment Center at the US Army Infantry School, support for this whole program is being cut off just prior to adapting results in operational Army school programs."

The Military Academy assesses changes in its curriculum through feedback "from a variety of sources (Department of the Army, surveys of cadets and graduates, returning graduates, Academic Board studies, etc.)"

2. Navy -- The Naval Academy uses the Graduate Performance Evaluation System "to get feedback from the fleet from recent graduates asking them for opinions on the effectiveness of the USNA program. Many of their comments have been incorporated into course curriculums." Naval ROTC uses an "informal feedback system," and Aviation Officer Candidate School (AOCS) relies on "program performance. . . by feedback from commands in the training pipeline. . ."

An in-house curriculum review board evaluates changes in the AOCS program. The latter program reported three barriers to innovation: a) a lockstep flow of students through the school, b) inadequate physical plant, i.e. only limited space available for a learning center, and c) excessive lag in obtaining hardware and software (other than that produced in-house).

The Naval Postgraduate School (NPS) assesses instructor performance via departmental chairmen's evaluation (specifics not given). Every year curricular programs are evaluated, and major reviews are done every three to five years. At NPS, "the greatest barrier to innovation is the time, money and effort needed to assess the advantages and disadvantages of the proposed innovations. . ."

The Naval War College evaluates its programs' effectiveness by six means: a) Board of Advisors to the President, Naval War College; b) Office on Educational Credit of the American Council Education evaluation in terms of academic credit; c) course review by visiting professors and flag officers; d) student end-of-course critiques; e) outside educational consultants; f) continuous internal review.

3. Air Force -- A list closely similar to the foregoing was submitted by the Air Force Academy: a) informal critiques by officers working in the relevant technical specialities in the Air Force; b) formal evaluation by accreditation agencies; c) performance of Academy graduates on Air Force jobs and as graduate students; d) instructor course critiques at the completion of most courses; e) appointed committees to evaluate the curriculum; f) supervisor and peer instructor classroom visits; and g) feedback from civilian visitors. Air Academy staff did not feel that proposed educational innovations met with resistence; on the contrary, the introduction of new approaches is encouraged and supported. One problem, however, is the fact that certain "core" courses are taught to very large numbers of cadets by as many as 12 to 35 different instructors. Since all cadets in these courses are examined by the same tests, the flexibility permitted instructors in their teaching methods is somewhat limited. "Nevertheless, even in these core courses, as well as in the smaller noncore courses, individual instructors have considerable freedom to use individualized and innovative teaching techniques and materials to achieve maximum learning of the 'standardized' subject material."

Evaluation of Air Force professional development programs is largely a matter of student critiques, student and faculty surveys, and certain inspections by external groups, e.g. the Air University's Board of Visitors and the Professional Military Education Symposium of the vice commanders of the major commands. The single most serious hindrance to innovation in this area was seen as inadequate support for ADP requirements. The lead time for new ADP inputs into the Defense Department Planning, Programming, and Budgeting System is minimally eighteen months, and "frequently the personnel who initiate innovative requirements depart before initiation (of the innovation)."

5.7 CONCLUSIONS

1. Officer acquisition training fills the services' needs for qualified junior officers: about 17,000 new officers will be commissioned by the principal OAT programs during FY 1976. About 5 per cent ($358 million) of the DoD individual training and education budget is spent on this area, excluding ROTC and other non-active duty programs. There is a wide variation in the duration (e.g. 8 weeks to 4 years) and cost of particular training programs.

Professional development education provides intellectual and technical breadth to career officers and senior non-commissioned officers; approximately 14,000 men and women will participate during FY 1976. The cost is about 7 per cent ($520 million) of the total DoD individual training and education budget. This type of training is provided both in civilian and in-house institutions.

2. Officer training and education is highly traditional. Most takes place in college-like settings with their typical approaches: lectures, seminars, and reading. There are some striking applications of innovative technology, most notably at the Air Force and Naval Academies. What is conspicuously missing, however, is all data evaluating the new approaches followed in these and other centers. There are excellent opportunities to do systematic assessments on the effectiveness of officer training programs.

3. Professional development involves an inordinate amount of time during some officers' careers. Up to 25 per cent of the post-commissioning years are spent on this type of activity. The corresponding time for professionals in civilian life is, we believe, much less.

4. Non-resident, self-instruction through correspondence courses, has long been used in officer and non-commissioned officer professional development, and it is receiving more command emphasis at present. We are concerned about the apparent new emphasis for two reasons: (a) there is evidence to show that generally very few people complete correspondence courses, and (b) correspondence courses place an extremely high value on verbal fluency, which may not be necessary for many enlisted occupations. There is little evidence of specific Training Technology R&D support for non-resident instruction; e.g., we know very little about the cost-effectiveness of this type of training.

5. Most professional development education is provided in a lock-step fashion, with little attention to individual differences.

in learning rates, motivation, and the like. Related to this is the rigid system of career progression which does not make it easily possible to accelerate the promotions and responsibilities of outstanding young officers and non-commissioned officers.

6. There is a tendency for the services' training managers to embrace hardware technology uncritically for training programs. Much more attention seems to be paid to "how to teach" than to "what to teach" in these programs. Sometimes "media" is confused with the educational process, i.e., the medium becomes the message; as often happens in the civilian sector, gimmicks and gadgets are acquired without valid justification.

7. There are some barriers to training innovations, many of which can be changed by administrative action; e.g., high turnover among innovators and would-be innovators; too much emphasis on short-term, immediate-payoff projects; no reward for embarking on high-risk activities; and insufficient opportunity, due to course overloads, to permit experimentation.

8. The importance of what one briefer aptly called "the most important variable" should be underscored: the teacher. Instructors are of primary importance, and they are likely to remain so into the indefinite future. Better military teaching can be brought about in many ways, e.g., by sensible selection and career management of teachers, good preparation in the art of teaching, rewards provided for outstanding teachers, and hardware that serves to unburden and enhance the role of the instructor. Training Technology R&D should support the teacher, not supplant him.

5.8 RECOMMENDATIONS

1. Recognize the central importance of the teacher, in all military training, and take appropriate administrative (and R&D) steps to support him. The services should disabuse themselves of the notion that all men are equally skilled modules when they are assigned to training billets as instructors. As in recommendation 3, below, a good deal is known about teaching skills in the civilian sector, and this literature should be applied. A less-inhibited recommendation is that special career fields in training and education should be established; perhaps the British Army's experience would be instructive in this regard.

2. Initiate in-depth studies and experimental evaluations of the new training equipments that are currently being introduced into officer acquisition programs. A proportion of the budget for new types of training equipment should provide funds for evaluating their effectiveness. Existing data from other programs may be applicable in officer acquisition training; these products should be rediscovered and their findings used where possible.

Develop techniques and procedures, that will ensure new training media, will not be adopted uncritically. Require technology procurement to include quantitative evidence on anticipated benefits; cost-benefit analyses are needed <u>before</u> procurement, as well as in evaluations of utility <u>after</u> procurement.

3. Conduct research and development in the area of self-instruction, particularly the traditional correspondence course approach to training and education. Establish up-to-date data bases, for example, on course completion rates (both within and outside the military departments), and factors contributing to successful self-instruction (e.g., student, situational, and content variables). Initiate R&D leading to good cost effectiveness estimates for correspondence versus other training approaches.

4. Initiate comparative studies of civilian and military practices in professional development education, for example, on the duration and types of training employed for maintaining and broadening professional competencies.

5. In the area of professional development education, determine effective lead times between training courses and duty assignments (For example, should advanced speciality education occur immediately before an officer's utilization tour, or precede it by several years?)

REFERENCES (Chapter 5)

Most of the material on which this chapter is based comes from two sources: briefings and discussions with service representatives during the 18-19 February 1975 DSB Task Force meeting, and written responses to questions submitted to service agencies by Secretary Currie's 9 January 1975 memorandum. In addition, we have done some reading in the small but important literature on officer training and education. Following are annotated listings of a few sources judged to be significant in this area.

A. Cited References

1. Joseph Ellis and Robert Moore, School for Soldiers, Oxford University Press, New York, 1974. A balanced and thorough study of the Military Academy: what it is in the mid-Seventies, how it got to be that way, and prospects for change. Authored by two former instructors.

2. Comptroller General of the United States, Financial Operations of the Five Service Academies, Report to the Congress, February 6, 1975.

3. U.S. Naval Academy, Final Report on the Naval Academy's CAI Project, PR-0571-43, W. H. Sandeford, February 1972 (U).

4. Human Resources Research Organization, HumRRO Research on Officer Training, Professional Paper 24-70, W. A. McClelland et al., September 1970 (U). Contains four papers presented at Headquarters, Continental Army Command, on R&D in the officer training area.

B. Uncited References

1. Raoul Henri Alcala, "Education and Officer Attitudes." One of several talks given by the Panel on Civilian Education for the Military Officer, International Studies Association Convention, Washington, D. C., February 19-22, 1975.

2. Josiah Bunting, "The Humanities in the Education of the Military Professional." See 1. above.

3. Peter Dawkins, "Some Thoughts on the Education of Officers." See 1. above.

4. Amos A. Jordan and William J. Taylor, Jr., "The Military Man in Academia," The Annals of the American Academy of Political and Social Science, Vol. 406, pp. 129-145, March 1973.

5. Kurt Lang, "Military Career Structure: Emerging Trends and Alternatives," Administrative Science Quarterly, Vol. 17, pp. 487-498, December 1972. Reviews implications for the military profession of changes brought about by recent technological and organizational developments. Good analysis of officer utilization patterns.

6. Richard M. Rose, "Preparing the Officer." See 1. above.

7. Sam C. Sarkesian and William J. Taylor, Jr., "The Case for Civilian Graduate Education for Professional Officers," Armed Forces and Society, Vol. 1, No. 2, pp. 251-262, Winter 1975.

8. William J. Taylor, Jr., "Alternatives for Officer Education." See 1. above.

9. William J. Taylor, Jr. and Donald F. Bletz, "A Case for Officer Graduate Education," Journal of Political and Military Sociology, Vol. 2, No. 2, pp. 251-267, Fall 1974. Makes the case for officer professional development as essential for a Volunteer Force. (See also Franklin D. Margiotta, "Comment," and Taylor and Bletz, "Reply," Ibid., pp. 269-273.)

10. Adam Yarmolinsky, "Where Should the Officer Obtain his Education?" See 1. above.

CHAPTER 6

FLIGHT TRAINING TECHNOLOGY*

6.1 INTRODUCTION

This chapter is primarily concerned with the undergraduate training of pilots, navigators, and naval flight officers. Training in this category provides the basic individual flight skills needed for progression into advanced mission-oriented crew or unit training. Flight familiarization training, training for screening prospective aviators, flight training offered by ROTC and Academy units that relate to officer acquisition, and a category referred to as "other" flight training are also described. This chapter does not include advanced flight training except in the consideration of total training costs and perspective.

Undergraduate flight training merits special consideration for research support because of its ultimate impact on the quality of our operational forces, its high costs, the magnitude of its resource requirements, its inherent hazards, the environmental problems it generates, and the great amount of time it consumes.

For FY 1976, a training load of about 6,000 trainees is projected for undergraduate flight training. This represents approximately two per cent of the entire DoD load for individual training, but will require 17 per cent of the DoD budget for individual training, or $1.15 billion. It will require 19 per cent of the manpower in training support. Because of program differences between the services, cost comparisons per graduate cannot be made on any meaningful basis, but it is interesting to note that the average cost per graduate is approximately $197,000. The course lengths range from 36 weeks (Army) to 59 weeks (Navy).

The support facilities, equipment, energy, and geography required per trainee is equally disproportionate compared to other kinds of military training. While the hazards normally associated with flight training have been reduced to a phenomenally low level ($3.7 million in equipment damage and 7 fatalities in 1973), it is still very high as related to the numbers trained and compared to other training programs. Flight training produces other problems relating to noise and air pollution and competes with civilian aviation for space in the air.

Undergraduate pilot training has service-specific characteristics as well as areas of commonality. The Army program is restricted to the training of helicopter pilots and most of their graduates go directly to operational units. The Navy trains helicopter, jet, and prop pilots, whereas the Air Force confines its training to jet pilots. Both the Navy and the Air Force pilot graduates require additional training prior to an operational assignment. In the case of the Air Force, the advanced training can cost as much as $253,000 per trainee (F4-E) and take an additional 31 weeks. In

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this situation, the total training cost of getting a new pilot to an operational squadron is about $412,000, and it will take at least 81 weeks. But even this does not represent total training costs, as additional training will be required after assignment to an operational squadron to produce a combat-ready pilot.

Similarities between service training programs are most apparent in Army and Navy helicopter programs and Navy and Air Force jet-pilot programs.

All three services provide specific research support to undergraduate flight training. In FY 1975, this amounted to $8,741,000 for the Air Force, including salaries and contract funds, $4,170,000 for the Navy, and $500,000 for the Army. Based on the information each service provided the Task Force, it is not possible to categorize these funds by budget number, nor to compare them across services. It may be that the cost of equipment development is included in several of the figures. However, even this total of $13,411,000 for research represents only about one per cent of the flight training costs.

Whether or not this is an appropriate or adequate level of R&D support for achieving cost-effective undergraduate flight training is a good question, and a difficult one to answer. It will require an assessment of current and projected R&D programs for their potential to reduce costs and increase effectiveness, and this is the major concern of this chapter.

6.2 SCOPE OF FLIGHT TRAINING REQUIREMENTS AND COSTS

An adequate presentation of the requirements and costs of military flight training is necessary to dimensionalize the problems and opportunities for conducting research in this area. Most of the information is presented in tables to permit comparisons between services and to show yearly trends.

Flight Training Programs

Flight training programs provide basic flying skills required prior to operational assignment of pilots, navigators, and naval flight officers. Upon completion of flight training, a graduate is awarded "wings" and is classified as a "designated" or "rated" officer.

Table 6-1 shows the total undergraduate flight training loads for each service from FY 1973 through FY 1978. Loads for FY 1979 and FY 1980 are currently projected as being the same as FY 1978.

TABLE 6-1

TOTAL FLIGHT TRAINING LOADS, FY 1973 TO FY 1978*

Service/Component	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T	FY 1977	FY 1978
Army, Active	1,106	704	701	785	752	818	818
Army Reserve	19	16	18	15	10	10	10
Army Natl. Guard	72	69	40	36	22	22	22
Navy, Active	1,903	1,739	1,486	1,409	1,329	1,310	1,310
USMC, Active	807	988	1,053	919	912	773	773
Air Force, Active	4,506	4,062	3,138	2,554	2,806	2,656	2,663
Air Force Reserve	110	48	50	29	32	28	28
Air Natl. Guard	215	137	146	100	96	98	98
DoD, Active	8,322	7,493	6,378	5,667	5,793	5,557	5,564
DoD Reserve	129	64	68	44	42	38	38
DoD Natl. Guard	287	206	186	136	118	120	120
DoD Total	8,738	7,763	6,632	5,847	5,953	5,715	5,722

Table 6-2 below presents the costs and cost estimates of Flight Training. The figures in parentheses show student pay and allowances included in the figures immediately above.

TABLE 6-2

FLIGHT TRAINING COSTS*
($ Millions)

Service	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T
Army	145.8	121.2	96.2	107.3	25.3
	(9.8)	(14.4)	(15.5)	(16.9)	(5.0)
Navy	297.7	321.1	366.8	396.3	103.8
	(24.8)	(35.5)	(32.8)	(31.5)	(7.9)
USMC	50.8	53.8	57.5	57.0	14.2
	(15.8)	(12.8)	(14.2)	(12.7)	(3.2)
Air Force	548.5	511.8	608.4	593.6	143.8
	(59.2)	(48.0)	(41.1)	(34.8)	(9.3)
DoD	1,042.8	1,007.9	1,128.7	1,745.0	287.1
	(109.6)	(110.7)	(103.6)	(95.9)	(25.4)

* Since the Navy conducts almost all USMC undergraduate flight training, the Navy recommends that Navy and USMC flight training data be considered together.

Estimated DoD cost per graduate of Flight Training for FY 1976 is $125,201. Estimated cost per day per graduate of Flight Training for FY 1976 is $623.56.

Flight Familiarization

Flight Familiarization Training is a relatively small preliminary pilot-training program conducted by all services. The purpose is to motivate qualified candidates toward an aviation career, and to identify those candidates most likely to be successful in flying. Students are primarily drawn by the services from their officer acquisition programs, except for the Air Force which conducts a separate flight screening program for other candidates for Undergraduate Pilot Training. (Similar screening is accomplished during the first phase of Undergraduate Pilot Training by the other services.)

Data showing the scope and costs of these programs are given in the several tables that follow. Workload data attributable to students in officer acquisition programs (noted in parentheses) are not additive to total service loads, since they are either already within other servise loads or are included in participation data for ROTC and similar programs.

TABLE 6-3

TRAINING INPUTS, OUTPUTS, LOADS, FLIGHT FAMILIARIZATION PROGRAM, FY 1974-FY 1978

Service/Component	FY 1974			FY 1975			FY 1976			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army, All Components	(852)	(692)	-	(1052)	(852)	-	(452)	(372)	-	-	-
Navy, All Components	1075	767	61	1149	836	71	(1,159)	(843)	71	71	71
USMC Reserve			-			-	(225)	(200)	-	-	-
Air Force											
Active	764	759	55	230	200	12	279	236	15	11	24
Reserve	0	0	0	34	31	2	27	25	2	2	2
National Guard	106	108	8	95	85	5	95	85	5	5	5
USAF Academy and ROTC							(2,690)	(2,380)	-	-	-
DoD											
Active							279	236	15	11	24
Gd/Res Total							122	110	7	7	7
DoD Total							401	346	22	18	31

TABLE 6-4

FLIGHT FAMILIARIZATION TRAINING COSTS FOR FY 1973 TO FY 1976
($ Millions)

Service	FY 1973	FY 1974	FY 1975	FY 1976
Air Force	7.7 (2.2)	6.5 (.7)	5.7 (.3)	6.0 (.3)

Note: Figures in parentheses show student pay and allowances included in the figure immediately above.

Flight Familiarization Training in the Army includes instruction in basic ground and in-flight fundamentals of pre-solo, solo, basic instrument, and cross-country navigation. The ROTC flight program is authorized for each of the 291 Army ROTC host institutions. Training is given in fixed-wing civilian aircraft by Federal Aviation Administration approved civilian flying schools. The Military Academy (USMA) training is conducted at Fort Rucker, Alabama. The USMA course length is eight weeks and consists of ground school and 40 hours in the TH55 helicopter.

The Air Force conducts three programs in Flight Familiarization Training. The Pilot Indoctrination Program (PIP) at the Air Force Academy provides each qualified First Class cadet with 25.5 flight hours in the T-41. The 3253 Pilot Training Squadron (ATC) conducts the program with the assistance of instructors assigned to the Air Force Academy.

The Air Force ROTC Flight Instruction Program (FIP) is conducted by civilian contractors at 177 ROTC host institutions. Air University executes the contracts for FIP and the Commandant, AFROTC, establishes the curriculum. Operational supervision is accomplished by the FAA. Other candidates for Undergraduate Pilot Training enter the Flight Screening Program (FSP) conducted at Hondo AB, Texas. Each student pilot receives a maximum of 14 flight hours in the T-41. The program is conducted under contract with a civilian flying service.

No information was provided to the Task Force on Flight Familiarization in the Navy and Marine Corps.

Warrant Officer Pilot Training

In contrast to the other services, where all pilots are commissioned officers, a large portion of Army pilots are Warrant Officers. The training provided to Warrant Officer candidates in the Rotary Wing Aviation Course at Fort Rucker, Alabama, includes the same training given to Army Commissioned Officer students in Undergraduate Pilot Training. The course also serves as a Warrant Officer Candidate School. The course is 38.4 weeks in length and includes subjects designed to qualify the candidate as a Warrant Officer rather than solely as a pilot. The curriculum includes necessary flying instruction, associated academic subjects, and those instrument flight and academic subjects required to operate an aircraft safely under actual instrument conditions.

Each student is also qualified in the UH-1 utility helicopter to include the support of combat operations in a tactical environment.

Workload data for FY 1973 to FY 1976 and cost data for the same years are given in Tables 6-5 and 6-6, below.

TABLE 6-5

TRAINING INPUTS, OUTPUTS AND LOADS, WARRANT OFFICER PILOT TRAINING, FY 1973 TO FY 1976

Service Component	FY 1973			FY 1974			FY 1975			FY 1976
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load
Army, Active	404	360	390	346	350	257	309	200	209	207
Army Reserve	4	7	2	1	2	1	23	16	14	14
Army National Guard	26	21	14	20	20	14	52	36	36	35
TOTAL	433	388	406	367	372	272	384	252	259	256

TABLE 6-6

COSTS OF WARRANT OFFICER PILOT TRAINING FOR FY 1973-FY 1976
($ Millions)

Service/Component	FY 1973	FY 1974	FY 1975	FY 1976
Army	48.5	46.2	33.9	38.
	(1.6)	(.6)	(1.3)	(1.9)

Note: Figures in parentheses show student pay and allowances included in the figures immediately above.

Undergraduate Pilot Training

The largest of the flight programs, which is conducted by all of the services, is Undergraduate Pilot Training (UPT). Courses include sufficient flying training to allow the student to attain proficiency in the general class of aircraft (jet, prop, or helicopter) he will be flying in future assignments. Training through flying or in flight simulators is augmented by flight-related ground training and, ordinarily, some Officer professional development training to prepare the student for the responsibilities of a junior Officer.

Training data for FY 1973 to FY 1978 are given in Table 6-7. Costs of undergraduate pilot training for FY 1973 to FY 1976 are presented in Table 6.8.

TABLE 6-7

TRAINING INPUTS, OUTPUTS, LOADS, UNDERGRADUATE PILOT TRAINING, FY 1973-1978

Service/	FY 1973			FY 1974			FY 1975			FY 1976			FY 1977	FY 1978
Component	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army														
Active	594	539	542	527	574	358	522	473	370	1055	792	663	729	729
Navy														
Active	1371	1121	1464	1449	975	1278	1295	976	1098	1195	1030	1037	938	938
USMC														
Active	560	473	603	571	382	527	474	400	567	400	360	481	405	405
Air Force														
Active	1548	1351	1004	2313	2167	2527	2088	1936	1903	2010	1800	1557	1688	1647
Air Force														
Reserve	14	2	6	36	66	36	31	38	36	27	21	22	22	22
Natl. Guard	24	33	20	92	117	115	85	115	105	85	71	72	72	72
DoD														
Active	4073	3484	2609	4860	4098	4717	4379	3785	3938	4660	3982	3738	3760	3719
Gd/Re Total	38	35	26	128	183	151	116	153	141	112	92	94	94	94
DoD														
Total	4111	3519	2635	4988	4281	4868	4495	3938	4079	4772	4074	3832	3854	3813

TABLE 6-8

COSTS OF UNDERGRADUATE PILOT TRAINING FOR FY 1973-FY 1976

Service/Component	FY 1973	FY 1974	FY 1975	FY 1976
Army	67.1	91.0	77.8	83.8
Navy	261.8	259.7	299.7	330.4
USMC	16.7	13.0	14.1	13.2
Air Force	353.1	357.5	397.7	386.1

The Army conducts all undergraduate helicopter-pilot training for its own personnel and for the Air Force. There is no fixed-wing Undergraduate Pilot Training conducted by the Army. Training is at the Army Aviation School at Fort Rucker, Alabama. The student body is comprised of Army and Air Force Commissioned Officers, and Army Warrant Officer Candidates. The course length is 36.4 weeks with a curriculum in the Primary Phase (14 weeks) of flying instructions and associated accademic subjects to qualify Commissioned Officers and Warrant Officers in the primary rotary-wing flying techniques and helicopter use. In the Advanced Phase (22.4 weeks), students are instructed in those instrument flight and academic subjects required to operate an aircraft safely under standard rotary-wing instrument certification. Students are also qualified in the UH-1 utility helicopter to include the support of combat operations in a tactical environment.

The Navy conducts Undergraduate Pilot Training for all Navy and Marine Corps students. The training begins with a common core of basic ground training and primary flight training and then diverges according to whether the student is to be qualified in jet aircraft or helicopters (Marine Corps) or jets, helicopters, or propeller aircraft (Navy).

Course lengths, training sites, and aircraft used for training for each phase are given in Table 6-9.

TABLE 6-9

COURSE PHASING, NAVY/MARINE CORPS
UNDERGRADUATE PILOT TRAINING

Course Phase	Training Site	Course Length (weeks)	Type Aircraft
Environmental Indoctrination	NAS Saufley		
Aviation Officer Candidates		11	-
Officers		4	-
Primary (all students)	NAS Saufley	6	T-34B
Jet Training	NAS Kingsville, NAS Chase, &		
Basic Jet	NAS Pensacola	24	T-2
Advanced Jet		18	TA-4
Prop Training	NAS Corpus Christi		
Basic Prop		20	T-28
Advanced Prop		17	TS-2A
Helicopter Training	NAS Whiting		
Pre-Helicopter Basic Prop		14	T-28
Primary Helicopter		1	H-57
Advanced Helicopter		1	H-1

Because of the variation in course content, the standard Navy Undergraduate Pilot Training course can be as short as 46 weeks (for an Officer student qualifying in helicopters) or as long as 59 weeks (for an Aviation Officer Candidate qualifying in jets).

Undergraduate Pilot Training in the Air Force consists of ground training, professional Officer training, and techniques of flying high-speed jet aircraft. The course length is 48.5 weeks. Each student receives 210 jet hours. Training locations are Williams AFB, Arizona; Webb AFB, Texas; Reese AFB, Texas; Laughlin AFB, Texas; Vance AFB, Oklahoma; Columbus AFB, Mississippi; Craig AFB, Alabama; and, Moody AFB, Georgia.

Undergraduate Navigator Training

Each service except the Army has a program for training navigators. The purpose of Undergraduate Navigator Training is to provide sufficient skills and knowledge so that further training for the newly rated navigator can be limited to transition to aircraft used in operational units and employment of applicable weapons systems. Training data for FY 1973-FY 1978 and cost data for FY 1973 to FY 1976 are presented in Tables 6-10 and 6-11.

TABLE 6-10

TRAINING INPUTS, OUTPUTS, LOADS, UNDERGRADUATE NAVIGATOR TRAINING, FY 1973 TO FY 1978

Service Component	FY 1973 Input	FY 1973 Output	FY 1973 Load	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 1977 Load	FY 1978 Load
Navy														
Active	1059	550	439	914	497	461	762	486	388	710	460	372	372	372
USMC														
Active	187	126	100	217	115	110	227	151	140	194	159	122	111	111
Air Force														
Active	1548	1351	1004	1461	1356	997	1189	1250	773	922	900	578	542	542
Reserve	14	2	6	7	15	9	17	12	9	5	4	3	3	3
National Guard	24	33	20	18	14	11	43	44	28	26	24	16	16	16
DoD														
Active	2794	2027	1543	2592	1968	1568	2178	1887	1301	1826	1519	1072	1025	1025
Gd/Res Total	38	35	26	25	29	20	60	56	37	31	28	19	19	19
DoD														
Total	2832	2062	1569	2617	1997	1588	2238	1943	1338	1857	1547	1091	1044	1044

TABLE 6-11

COSTS OF UNDERGRADUATE NAVIGATOR TRAINING, FY 1973 TO FY 1976
($ Millions)

Service	FY 1973	FY 1974	FY 1975	FY 1976
Navy	35.5	61.3	67.1	65.8
USMC		1.7	2.2	2.0
Air Force	59.1	58.1	60.6	53.4
DoD Total	94.6	121.1	129.9	121.2

The Naval Flight Officer training program (for Navy and Marine Corps personnel) begins with the same ground training phase given to pilots (4-11 weeks). This is followed by a basic 24-week phase covering navigation, meteorology, radar systems, and other fundamentals. A student then proceeds to one of five advanced phases: radar intercept officer (10 weeks); basic jet navigator (4 weeks); airborne electronic warfare officer (8 weeks); airborne tactical data systems officer (12 weeks); or multi-engine navigator (8 weeks).

The Air Force Undergraduate Navigator Training provides academic instruction in basic navigation, map reading, aviation physiology and aircraft systems, and equipment which includes radar, radio aids, loran, consolan, doppler and astro-trackers. Flight training is conducted in high/low altitude map reading, radar procedures, day/night celestial, grid, overwater navigation, and use of combined navigational aids. The current 33 week program is conducted at Mather AFB, California and calls for 40 hours in the T-29 and 120 hours in the T-43.

Other Flight Training

This category covers other miscellaneous types of flight training as described below. Load and cost data for FY 1974 to FY 1978 are summed at the end of this section in Tables 6-12 and 6-13.

The Army includes in this category courses for instructor pilots and specific pilot qualification courses in various aircraft. All of the courses, from 2 to 12 weeks in length, are conducted at the US Army Aviation Center, Ft. Rucker, Alabama. Curriculum includes qualification courses in fixed-wing multi-engine, OV-1, rotary-wing, CH-47 aviator, AH-1G aviator. There are also instructor pilot courses for U-8, U-21, OV-1, UH-1, OH-6, OH-58, CH-47, CH-54, and AH-1G. Additional courses are M-22 gunnery, rotary-wing instrument, and rotary-wing flight examiner.

The Navy does not report training in this category, inasmuch as postgraduate flight training is conducted under operational command auspices. The Marine Corps data include postgraduate advanced pilot and navigator training designed to provide training in a particular aircraft community before assignment to an operational squadron.

The Other Flight Training in the Air Force consists of the following:

Course	Training Site	Course Length (Weeks)
Navigator Bombardier Training	Mather AFB, Calif.	10-14
Electronic Warfare Officer Training	Mather AFB, Calif.	25
Pilot Instructor Training	Randolph AFB, Tex.	13.6
Instrument Pilot Instructor School	Randolph AFB, Tex.	6
Navigator Instructor Training	Mather AFB, Calif.	
Medical Officer Flight Familiarization		6
ATC Instructor Training	Randolph AFB, Tex.	4
Flying Training Commanders	Randolph AFB, Tex.	1
Rotary Wing Qualification Course		12
Air Force Academy Instructor Training		2
Foreign Specialized Flying	Webb AFB, Texas	10-38

Most Air Force postgraduate flight training is conducted under operational command auspices.

TABLE 6-12

TRAINING INPUTS, OUTPUTS, LOADS, OTHER FLIGHT TRAINING, FY 1974 TO FY 1978

Service	FY 1974			FY 1975			FY 1976			FY 1977	FY 1978
Component	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army											
Active	984	1008	134	965	1017	109	743	673	122	89	89
Reserve	106	89	13	77	77	9	94	78	15	10	10
Natl Guard	346	342	39	119	143	14	213	177	36	22	22
USMC											
Active	775	775	351	694	694	346	691	691	316	257	257
Air Force											
Active	2330	2343	483	2100	2057	450	2014	1942	404	415	415
Reserve	12	12	5	10	10	3	5	5	2	1	1
Natl Guard	5	4	3	34	34	8	31	31	7	5	5
DoD											
Active	4089	4126	968	3759	3768	905	3448	3306	842	761	761
Gd/Res Tot	469	447	60	240	264	34	343	291	60	38	38
DoD Total	4558	4573	1028	3999	4032	939	3791	3597	902	799	799

TABLE 6-13

COSTS OF OTHER FLIGHT TRAINING, FY 1973 TO FY 1976
($ Millions)

Source	FY 1973	FY 1974	FY 1975	FY 1976
Army	29.5	30.2	18.4	23.6
	(2.2)	(4.1)	(2.6)	(3.0)
USMC	31.9	39.1	41.2	41.9
	(3.9)	(5.6)	(5.8)	(5.4)
Air Force	49.9	65.1	70.0	77.6
	(6.5)	(5.0)	(4.9)	(4.8)
DoD Total	111.3	134.4	129.6	143.1
	(12.6)	(14.7)	(13.3)	(13.2)

Note: Figures in parentheses show student pay and allowances included in the figure immediately above.

ADVANCED FLIGHT TRAINING

In each of the services, graduates of undergraduate pilot and undergraduate navigator training receive supplementary training in the specific aircraft they will be flying on operational missions. Emphasis is placed on crew training and performance under conditions which would be encountered in combat. Marine Corps advanced flight training loads are included within Other Flight Training loads, as also is centrally conducted Army advanced flight training. Most of the advanced flight training in the Army, Navy, and Air Force is considered crew training and is discussed in the chapter on Crew/Group/Team/Unit training.

6.3 DESCRIPTION OF FLIGHT TRAINING PROGRAM: U.S. ARMY

The purpose of this section is to describe the flight training programs for each of the services. While the amount of information is somewhat overwhelming, it is an essential basis for relating later discussions on specific research and application projects.

Description of the Army ROTC and USMA Flight Training Program

Program Objective and Character. The objective of the program is to provide flight instruction of sufficient scope and duration to qualify selected students in the principles of flying Army-type aircraft. The course includes instruction in basic ground and in-flight fundamentals of pre-solo, solo, basic instrument, and cross-country navigation. Successful completion of the program is based upon the recommendation of flight instructors, flight examiners, and in the case of ROTC, the Professor of Military Science (PMS). The objective of these programs is to familiarize a selected group of future Officers with the aviation program,

not to qualify them as pilots. The program provides a screening process for the Army and experience has shown that the attrition in the initial entry rotary-wing course experienced by Officers who have attended ROTC or USMA flight training is lower than for Officers who have not.

Courses and Course Lengths. (a.) The Army ROTC Flight Instruction Program is conducted as a voluntary extracurricular activity for cadets in their final year of ROTC. The instruction does not modify the primary purpose of the ROTC program or alter prescribed ROTC programs of instruction. The instruction is completed within a period of four months, if possible, and will in no event exceed nine months. The Federal Aviation Administration (FAA) approved standardized flight instruction program is used. This consists of 35 hours of ground instruction and 36½ hours of flight instruction. An additional 3 hours of flight time may be authorized by the local Professor of Military Science (PMS), the Commander of the ROTC Department, to provide supplemental instruction when necessary. Flight instruction is conducted in fixed wing civilian aircraft by FAA approved civilian flying schools. (b.) The USMA training is conducted at Fort Rucker, Alabama. The USMA course length is eight weeks and consists of ground school and 40 hours in the TH55 helicopter.

Training Sites. (a.) The ROTC flight program is authorized for each of the 291 Army ROTC host institutions, provided that an FAA approved flight instruction school is available within a reasonable distance of the campus and medically qualified candidates are available. A joint program involving two or more institutions is encouraged where geographical location will permit. In FY 1973, 723 cadets at 209 institutions enrolled in the program; 538 were recommended by their instructors for further aviation training, an average of 3.5 students per participating institution. In FY 1974, 719 students have been enrolled at 207 institutions. An additional 89 applicants are awaiting approval of their applications (an average of 3.9 students per participating institution). The estimated enrollment for FY 1975 is 1,000 students.

(b.) The USMA Training Sites are:

FY 1973	FY 1974	FY 1975
Ft Wolters, Texas	Ft Wolters, Texas	Ft Rucker, Alabama

(c.) Enrollments:

	FY 1973	FY 1974	FY 1975
ROTC	723	719	1,000
USMA	50	50	50

(d.) The training support manpower is not available for ROTC Flight Training. The training support manpower for the USMA Flight Training is not available.

Calculations of Proposed Training Load Authorizations. (a.) ROTC training quotas are determined by the Department of the Army based on annual requirements for aviators. Supernumaries are not a factor in this type of training. (b.) Attrition experience for ROTC from FY 1970 to the present is as follows:

	FY 1970	FY 1971	FY 1972	FY 1973	FY 1974	FY 1975
Students Enrolled	1,156	855	638	723	*800	*1,000
Completions	924	682	518	538	*640	* 800
Attrition	20%	20%	19%	25%	*20%	* 20%

*Estimated

Training Improvements.--On 1 July 1973, a new agreement went into effect between the Department of Transportation and the military services. This agreement defines the responsibilities of FAA and the services. One of the greatest benefits to the services is that the FAA will provide flight evaluation of each Flight Instruction Program student in training following his first solo cross-country flight. This assures quality control of the instruction given by the private flying schools.

Management of Training.--The Department of the Army establishes policy and training quotas. The Commander, Training and Doctrine Command is responsible to direct, supervise, inspect and coordinate all matters pertaining to the selection of participating institutions, organization, and training in the conduct of the ROTC and the USMA program. ROTC Region commanders operate, administer, and supervise the conduct of the program in their own areas. Professors of Military Science select flight trainees and directly supervise cadets engaged in the training program. The Superintendent of the United States Military Academy establishes selection criteria and supervises cadets engaged in the training program.

Description of the Warrant Officer Pilot Training Program

Program Objectives and Character.--The objective of the Warrant Officer pilot training program is to provide selected Warrant Officer Candidates with the background in aviation subjects and skills necessary so that they arrive in operational units fully receptive to unit training programs, capable of professionally and safely executing their respective flying roles.

Warrant Officer Pilot Training.--The training provided to Warrant Officer Candidates in the Rotary Wing Aviation Course at Fort

Rucker, Alabama, includes the same training given to Army Officer students in Undergraduate Pilot Training, discussed in the next section. However, the course also serves as a Warrant Officer Candidate school. It is therefore two weeks longer (38.4 weeks) and includes subjects designed to qualify the candidate to serve as a warrant officer rather than solely as a pilot. The attrition rate for the course averages 30 per cent.

Initial Entry Rotary Wing Training. The Army/Warrant Officer Candidate Rotary Wing Aviator Course is divided into a Primary Phase and an Advanced Phase. The Primary Phase of 16 weeks is designed to provide the necessary flying instruction and associated academic subjects to qualify the student in helicopter use. During the 22 week, 2 day Advanced Phase, students are provided those instrument flight and academic subjects required to operate an aircraft safely under actual instrument conditions and necessary for the awarding of standard rotary-wing instrument certification. During this phase of training, students are also qualified in the UH-1 utility helicopter to include the support of combat operations in a tactical environment.

Description of the Army Officer Pilot Training Program

Program Objectives and Character. The objective of the Officer pilot training program is to provide selected Officers with the background in aviation subjects and skills necessary so that they arrive in operational units fully receptive to unit training programs, capable of professionally and safely executing their respective flying roles. The Army has conducted all undergraduate helicopter pilot training for its own personnel and for the Air Force since 1970. (The Army now conducts no fixed-wing Undergraduate Pilot Training.) With the cessation of flight training at Fort Wolters, Texas, all this training is now consolidated at the Army Aviation School at Fort Rucker, Alabama. The course length is 36.4 weeks, with an average attrition rate over the period of 1970-1975 of about 10 per cent.

Initial Entry Rotary Wing Training. The Army Officer Rotary Wing Aviator Course is divided into a Primary Phase and an Advanced Phase. The Primary Phase of 14 weeks is designed to provide the necessary flying instruction and associated academic subjects to qualify commissioned officers in the primary rotary wing flying techniques and helicopter use. During the 22 week, 2 day Advanced Phase, students are provided those instrument flight and academic subjects required to operate an aircraft safely under actual instrument conditions and necessary for the awarding of standard rotary-wing instrument certification. During this phase of training, students are also qualified in the UH-1 utility helicopter to include the support of combat operations in a tactical environment.

Description of Other Flight Training

The Army includes in this category courses for instructor pilots and specific pilot qualification courses in aircraft other than those used in the undergraduate program. Most of the courses are short, ranging from 2 to 12 weeks. All such courses (19) are conducted at the US Army Aviation Center, Ft Rucker, Alabama.

Description of Army Advanced Flight Training

Graduates of undergraduate pilot training receive supplementary training by the operational unit to which the new pilot is assigned and in the specific aircraft they will be flying on operational missions. Emphasis is placed on crew training and performance under conditions that would be encountered in combat.

6.4 DESCRIPTION OF THE AIR FORCE FLIGHT TRAINING PROGRAMS

Air Force Flight Familiarization Program

Flight Screening Program (FSP), Hondo AB, Texas. The objective of this program is to identify those students who have the capability to progress through and complete the USAF 210-hour jet UPT program and to screen out those who do not have that capability. The student pilots in this program receive a maximum of 14 hours T-41 flying each. The program is conducted by a civilian flying service under contract with military personnel serving as contract monitors and quality control for the program. FY 1974 entries number 758, whereas graduates number 670.

Pilot Indocrination Program (PIP) USAFA, Colorado. The purpose of PIP is to motivate all physically qualified AFA cadets toward a rated career in the Air Force. It also identifies those cadets who possess the basic aptitude to be Air Force pilots and allows those who do not possess this aptitude to direct their abilities toward other career fields. The program is conducted in accordance with a syllabus prepared and published by the Air Training Command. The 3253 Pilot Training Squadron (ATC) conducts the program with the assistance of instructors assigned to the Air Force Academy. Each cadet receives 25.5 flight hours in the T-41. All First Class cadets who volunteer and are medically qualified for UPT must participate unless unusual circumstances make participation impractical. FY 1974 entries number 529, and graduates number 511.

USAF ROTC Flight Instruction Program (FIP). The purpose of the Air Force ROTC Flight Instruction Program is to motivate qualified cadets toward a career in the Air Force. It also provides a screening device to identify pilot training applicants who me[illegible] the basic aptitude/attitude requirements for Air Force pilot training. The course is conducted by civilian contractors at

177 locations and is an integral part of the AFROTC program. Air University executes the contracts for FIP and the Commandant, AFROTC, establishes the curriculum. Operational supervision is accomplished by the FAA. All cadets who qualify for pilot training must participate in the program unless (a.) the school does not provide FIP (b.) they possess a Private Pilot Certificate or (c.) participation would place an extreme or unusual hardship on the cadet. The Flight Instruction Program is conducted at 177 locations in 47 states and the District of Columbia. This program is reported on a calendar year basis to the Secretary of the Air Force as required by Public Law 88-647 (dated 13 October 1964). The report is submitted in January of each year and covers the preceeding fiscal year and one half of the current fiscal year. Participants, graduates, and eliminees for FY 1973 and July-December FY 1974 are as follows:

Participating Cadets FY 1973	1791
Successful Completion FY 1973	1546
Eliminations FY 1973	229
Participating Cadets FY 1974	1542
Successful Completion FY 1974	411
Eliminations FY 1974	80

Air Force Undergraduate Pilot Training

The purpose of Undergraduate Pilot Training is to qualify officers to perform the duties and assume the responsibilities of a pilot. Annual training loads for the UPT, UNT, EWOT, and NBT programs are driven by several factors such as the budget, Congressional approval of pilot/navigator training rates, Air Force requirements for rated officers, etc. Consequently, the numbers will vary each fiscal year. For FY 1974 graduates, the number of Air Force trainees entering UPT was 2,791.

Air Force Undergraduate Navigator Training, Mather AFB, California

The current program calls for 40 hours in the T-29 and 120 in the T-43 and is 33 weeks in duration. For FY 1974 graduates, the number of Air Force trainees entering UNT was 1,547.

Other Air Force Flight Training

NBT, Mather AFB, California. Navigator Bombardier Training (NBT) is charged with preparing qualified navigators to perform duties as navigator-bombardiers in the Strategic Air Command. Academic instruction is conducted in the fundamentals of radar navigation and bombardment in trainers equipped with a typical bombing-navigation system. No actual flying training is accomplished. Trainer instruction includes pre-flight, operational and emergency procedures associated with the bombing-navigation system and instruction on operation and delivery of air-to-ground missile systems. Weapons delivery training includes instruction on pre-flight, monitoring,

control, and delivery of both conventional and nuclear weapons associated with SAC B-52 aircraft. Two courses of instruction are conducted: one 14 weeks in duration and the other 10 weeks. Differences in course lengths are attributable to the two different bomb-nav systems taught. For FY 1974 graduates the number of Air Force trainees entering NBT was 331.

EWOT, Mather AFB, California. Electronic Warfare Officer Training (EWOT) qualified rated navigators to perform duties and responsibilities as an Electronic Warfare Officer. Academic training includes electronic fundamentals, radar principles, electronic warfare concepts, and tactics plus pre-flight inspection and inflight operation of specialized airborne electronic warfare equipment including receivers, signal analyzers, direction finders, recorders, transmitters, and chaff dispensers. All instruction is given in a ground-based simulator and course duration is 25 weeks. For FY 1974 graduates, the number of Air Force trainees entering EWOT was 225.

Pilot Instructor Training (PIT), Randolph AFB, Texas. The purpose is to qualify rated Air Force pilots as instructor pilots in either the T-37 or T-38 aircraft who are able to accurately analyze a student pilot's performance and improve it through simultaneous demonstration and instruction. FY 1974 entries were 418, and graduates were 418 in number. T-38 FY 1974 entries numbered 368, and graduates were 351.

Instrument Pilot Instructor School (IPIS), Randolph AFB, Texas. The purpose of IPIS is to qualify rated pilots as instrument instructor pilots. Fixed Wing FY 1974 entries were 209, and graduates were 224. Rotary Wing entries were 33, and graduates were 34 in number.

Navigator Instructor Training (NIT), Mather AFB, California. ATC Navigator Instructor Training qualifies a rated navigator as an instructor in the UNT, NBT, or EWOT courses. Academic instruction is provided in the psychology of learning, techniques of instruction, evaluation, and other related teaching skills as well as the applicable aircraft, trainers, and simulators. Flying training, if applicable, is accomplished for the course of instruction to which the instructor will be assigned. FY 1974 entries - 111, graduates - 111.

Air Force Advanced Flight Training

The USAF has about 125 flying training programs listed in AFM 50-5, Formal Schools Catalog. These training programs are necessary due to the number of different types and models of aircraft in the Air Force inventory and to provide appropriate training considering the various course objectives and the varied experience levels of those receiving the training.

6.5 NAVY FLIGHT TRAINING PROGRAMS

Program Objectives and Character

Flight training programs provide basic undergraduate training using a multi-track system for prospective naval aviators in jet, multi-engine

and helicopter type aircraft and for naval flight Officer, in support of the Tactical Air, Anti-submarine Warfare and Advanced Early Warning/ Electronic Warfare missions. These programs vary in length from 38 to 55 weeks, and culminate in an Officer being designated a Naval Aviator or a Naval Flight Officer, receiving wings, and being categorized as a "rated" Officer. All rated Officers are Commissioned Officers.

The objective of the undergraduate pilot training program is to produce Naval Officers who are capable of operating an aircraft in such a manner that additional training required, in order to accomplish a specific mission, is limited to transition to fleet aircraft and mission weapon system employment.

The methodology employed to measure attainment of this objective utilizes both an internal and external evaluation system. The internal system contains a complex monitoring system based on required levels of performance for each stage of training. The external evaluation system is composed of an informal system that utilizes continuous feedback by the ultimate user, the operational forces. Also, frequent studies of fleet pilot performance are correlated with training grades to identify undertraining and overtraining areas. After review and analysis, modifications to existing programs are accomplished to effect needed revisions.

The objective of the Undergraduate Naval Flight Officer Training program is to produce a Naval Officer who is a competent, confident, able airman. He must perform such duties as: monitoring assessment of status and control of normal and malfunctioning aircraft systems, planning and accomplishment of a predetermined flight profile utilizing navigation aids and principles, the relay of information to/from and within the aircraft via visual or electronic means, and the uniquely military employment of an aircraft and its associated systems. The same methodology is employed to measure attainment of these objectives and as described in the preceding paragraph.

Course and Course Lengths

Undergraduate Jet Pilot Program. The undergraduate jet pilot training program is based on a concept of "building block" training. It commences with a course in basic aeronautical and aviation physiological foundation knowledge. The student is then introduced to actual flying while undergoing a six-week primary flight training course designed to introduce him to flying in a low-performance aircraft, provide aviation acclimation, and flight aptitude screening. The student then progresses to 26 weeks of basic jet training for development of basic skills in T-2 aircraft including instruments, formation flying, gunnery, night flying, and carrier qualification. Advanced jet training follows to develop advanced skills in instruments, formation, weapons, air-combat maneuvering, and carrier qualification, a 20 week program. This completes the student's undergraduate jet pilot training and produces a naval aviator, ready for independent combat and carrier-qualified; additional training is limited to transition to fleet aircraft and mission weapon system employment.

Undergraduate Prop/Multi-engine Pilot Training. This program is also a building block training evolution. It commences with a three-week course in basic aeronautical and aviation physiological foundation knowledge. The student is then introduced to actual flying while undergoing a six-week primary-flight training course designed to introduce the student to flying in a low-performance aircraft, provide aviation acclimation, and flight aptitude screening. The student progresses to 19 weeks of basic prop training for development of basic skills in the T-28 aircraft, including instruments, formation flying and night flying. Following successful attainment of the performance standards, the student proceeds to the 17 week advanced phase for multi-engine training in the TS-2A aircraft to develop multi-engine coordinated crew skills in instruments, navigation, and night flying. This completes the student's undergraduate prop/multi-engine training and produces a naval aviator capable of performing routine contact and instrument pilot operations in multi-engine aircraft, and prepared to function operationally as a copilot with additional training limited to transition to fleet aircraft and mission weapon system employment.

Helicopter Training Program. As with the other pilot training programs, this training begins with basic aeronautical and aviation physiological foundation knowledge. Flight training for helicopter pilots is tailored to satisfy specific Navy and Marine Corps requirements. Fixed and rotary-wing instruction is employed because: (1) it costs less, (2) it produces a better pilot, and (3) it meets Marine Corps requirements for dual qualification. The student is introduced to actual flying while undergoing six-weeks primary-flight training, which is designed to introduce the student to flying in a low-performance aircraft, provide aviation acclimation, and flight aptitude screening. The student then moves into 19 weeks of pre-helo training for development of basic skills in the T-28 aircraft, including instruments, formation, and night flying. The student then proceeds to the five-week basic helicopter phase provided in the TH-57 aircraft to develop basic skills in the helicopter contact navigation and night flying. This is followed by 11 weeks of the advanced helicopter training phase in the TH-IL to develop skills in instruments, helicopter basic tactics, carrier qualification, and night flying. This completes the student's undergraduate helicopter pilot training and produces a naval aviator qualified for routine contact and instrument pilot operations in helicopters and prepared to function operationally as a copilot with additional training limited to transition to fleet aircraft and mission weapon system employment.

Naval Flight Officer Course. After the same three-week course in basic aeronautical and aviation physiological foundation knowledge, the student moves to the 20-week basic naval flight officer training phase, providing basic skills and knowledge in navigation, meteorology, electronics, radar systems, computer systems, electronic warfare, and communications. Practical flight skills are developed through flight acclimation in the T-34B, 1D23 computerized navigation/communications simulator, T-2B for jet acclimation and high-speed jet navigation and the T-39 for jet instrument navigation. The student proceeds subsequently to one of the advanced naval flight officer training phases: Radar Intercept Officer (10 weeks); Basic Jet Navigator

(4 weeks); Airborne Electronic Warfare Officer (8 weeks); Airborne Tactical Data Systems Officer (12 weeks); or Multi-Engine Navigator (8 weeks). These phases provide specific foundation skills and knowledge training to limit post-designation training to transition to a fleet aircraft and mission weapon system employment.

TABLE 6-14

SUMMARY OF NAVY FLIGHT COURSES AND LENGTHS

PILOT TRAINING (IN WEEKS)	FY 1973	FY 1974	FY 1975
Common to all			
NASC *AOC	11	11	11
OFF	4	4	4
Weighted Average	7	7	7
Primary	6	6	6
TOTAL COMMON TRAINING	13	13	13
JET: Basic	28	26	24
Adv.	20	18	18
TOTAL JET (incl. NASC Prim.)	61	57	55
PROP: Basic	25	22	19
Adv	17	17	17
TOTAL PROP (incl. NASC Prim.)	55	52	49
HELO: Pre Helo	20	19	19
Prim. (H57)	5	5	5
Adv. (H1)	10	10	11
TOTAL HELO (incl. NASC Prim.)	48	47	48

NFO TRAINING	FY 1973	FY 1974	FY 1975
Wt/d. Avg. NASC (wt'd)	7	7	7
Basic (VT-10)	18	20	24
Adv. (wt'd)	9	8	7
TOTAL NFO TRAINING	34	35	38

TABLE 6-15

TRAINING SITES AND WORKLOADS

Site	Average Workload FY 73	Average Workload FY 75	Trng/Supp FY 73 Mil	Trng/Supp FY 73 Civ	Manpower FY75 Mil	Manpower FY75 Civ
NAS Pensacola Fla	--	345	584	--	1,161	38
NAS Meridian Mississippi	--	206	1,243	--	977	36
NAS Kingsville Corpus Christi, Tex	--	224	1,173	--	1,155	54
NAS Chase Corpus Christi, Tex	--	198	1,122	--	902	62
NAS Corpus Christi Corpus Christi, Tex	--	282	1,237	--	1,369	69
NAS Whiting Pensacola, Fla	--	572	1,871	--	1,671	51
NAS Saufley Pensacola, Fla	--	254	540	--	366	20
NAS Ellyson Pensacola, Fla						

All of the above activities report to the Chief of Naval Air Training who reports to Chief of Naval Education and Training.

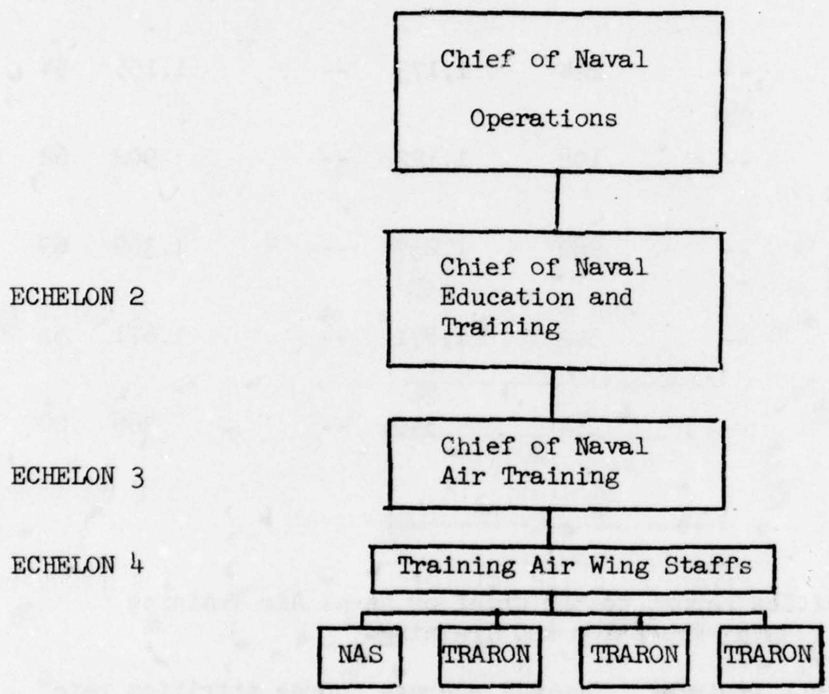
Attrition Rates in Flight Training. Overall average course attrition rate in normal pilot training is about 25 or 30 per cent. The exact experienced attrition rates over the past decade are as follows: FY 1965, 22%; FY 1966, 23%; FY 1967, 30%; FY 1968, 28%; FY 1969, 25%; FY 1970, 30%; FY 1971, 31%; FY 1972, 19%; and FY 1973, 30%. For planning purposes, an average attrition rate of 26.5 per cent is used to establish flows and input quotas. The attrition by major procurement source is as follows: Aviation Officer Candidate, 30 per cent; USN, 15; USNR, 25; Aviation Reserve Officer Candidate, 20--for an overall rate of 27.3 per cent for the Navy; US Marine Corps, 18; US Marine Corps Reserve, 25--for an overall rate of 23.6 per cent for the Marines.

More than 50 per cent of pilot training attrition is due to "dropped at own request" (not aviator material or lacking motivation). This one factor fluctuates very erratically and is influenced by internal and external forces such as the general climate of opinion in the country, the stability

of the economy, student perception of Congressional actions, and a draft vs. all-volunteer force. Most of these factors affecting motivation are essentially uncontrollable by the service and have been the subject of many studies. The procurement tests measure, insofar as possible, motivation of the prospective students. While progress has been made in this area, it remains a problem we have for future effort.

Management of Training

The management of Naval flight training may be described in the organizational chart as follows:



CNO — -Establish policy and training requirements, approves Pilot Training Rates and maintains curriculum control.

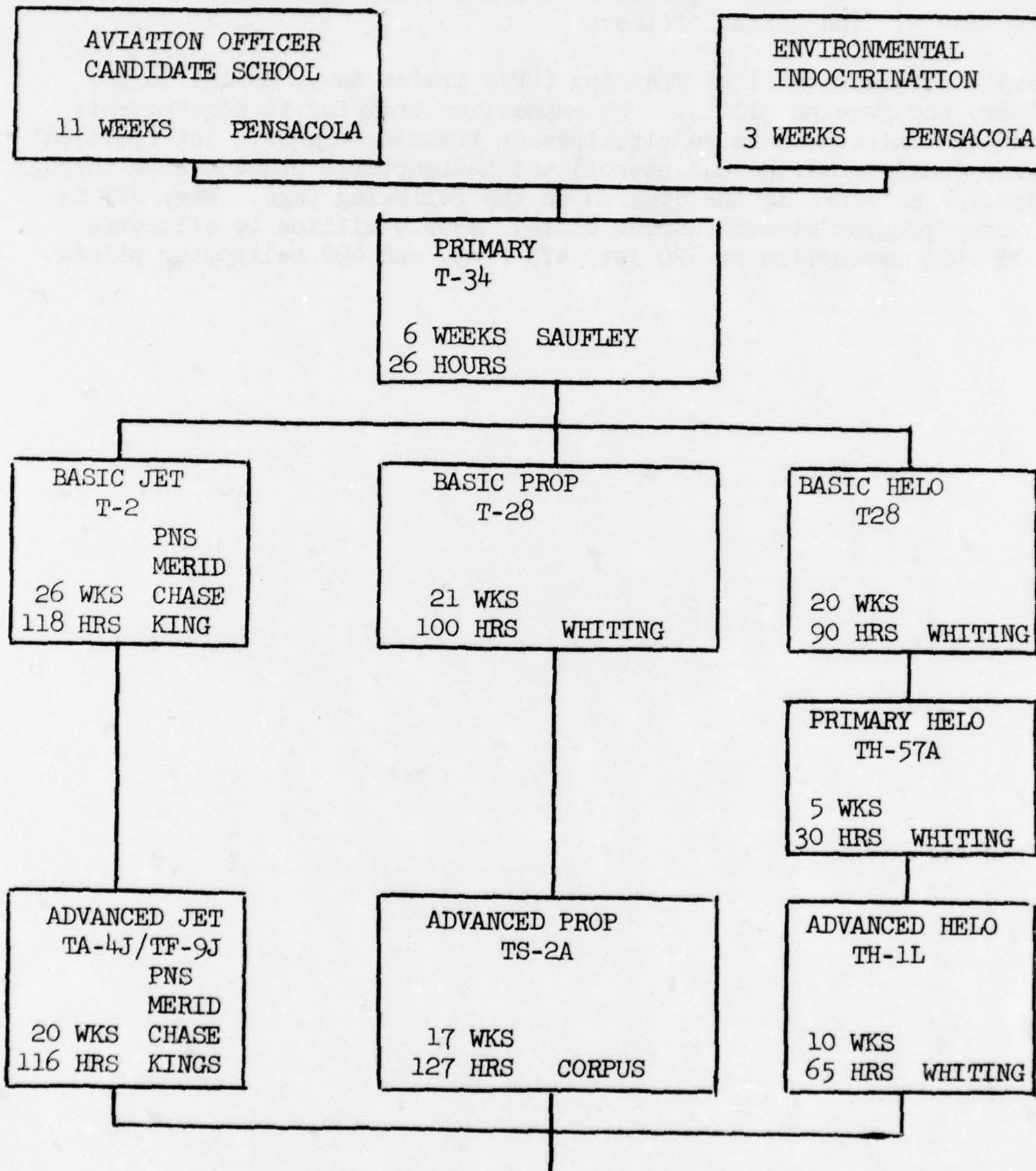
CNET — -Exercise command and support authority by coordinating asset availability with training rate requirements. Measure the cost effectiveness and efficiency of the CNATRA conducted program in relation to CNO approved Planning Factors. CNET maintains continual liaison with Fleet Commanders to determine product satisfaction.

CNATRA — -Develop, implement, and control flight training syllabi and flight instructional methods to assure uniform effective and efficient training.

TRAINING WING COMMANDERS -Establish and monitor a dynamic standardization program to ensure safe and effective training of naval aviators and flight officers.

Navy Undergraduate Pilot Training (UPT) trains Navy, Marine Corps, Coast Guard and foreign pilots. UPT emphasizes training to requirements and conducts training in three pipelines or training tracks: jet (Tactical Air), Prop (anti-submarine and patrol) and helicopter. Student flow through each pipeline as shown in the diagram on the following page. Navy UPT is funded under program element number 81114. $392.9 million is allocated to the FY 1975 production of 620 jet, 475 Prop, and 492 helicopter pilots.

PRESENT
PILOT TRAINING SYSTEM



	JET	PROP	HELO
FLIGHT HOURS	260	253	211
SIMULATOR HOURS	69	59	36
WEEKS	50	44	41

6.6 SCOPE OF TRAINING TECHNOLOGY R&D SUPPORT

The scope of training technology support to flight training is summarized for each of the services. Primary attention is focused on existing programs, programs recently completed, or programs to be implemented in the very near future.

Army

Prior to the establishment of the U.S. Army Research Institute (ARI) for the Behavioral Social Sciences, all of the research relating to Army flight training was conducted by HumRRO, a Federal Contract Research Center (FCRC). Their program related to the development of performance measures, training methods and training-device design, requirements, evaluation, and utilization. With the assistance of operational personnel, objective measures of pilot performance were developed and incorporated in flight tests given in the primary phase of helicopter training. Several low-cost training aids such as part-task and procedure trainers were developed and training programs for their utilization prepared and operationally evaluated. Several dynamic trainers such as the converted Link Trainer and the GAT-II were experimentally evaluated, and a program for the use of the GAT-II was developed. An outstanding development accomplished by HumRRO was in their conceiving and supporting the development of the Synthetic Flight Training System (SFTS), also referred to as the 2B-24, Flight Simulator for the HU-1 helicopter.

Currently, HumRRO is being phased out as an FCRC and research is being conducted (or monitored) by ARI. Programs receiving the greatest emphasis at this time relate to flight simulation and Nap-of-the-Earth (NOE) helicopter flight. They include the measurement of pilot performance in NOE flight and new training concepts in support of NOE flight.

A brief summary of ARI work in Aircrew Performance Enhancement, accomplished in FY 1975 and projected for FY 1975 and 1976, is given in Appendix 6-1. These efforts are categorized as Advanced Development and Technology-Base R&D.

Accomplishments

Integrated Pilot Performance Research Program. The area of pilot performance research is sufficiently important to deserve an integrated plan which defines Army requirements for this research, integrates the efforts of Army laboratories, and recommends action. In order to develop the information needed for this plan, a Conference on Aircrew Performance in Army Aviation was held at Ft. Rucker, Alabama 27-29 November 1973. Based on conference conclusions, the needed research plan has been written and has been published as part of the Conference Proceedings.

Pilot Performance Flight Tests. For the development of meaningful training recommendations, it is first necessary to determine what

the actual operational proficiency of rotary-wing pilots is. A program of pilot proficiency testing has, therefore, been developed which exposes pilots selected on the basis of flight experience and qualifications to a series of simulated combat missions. Twenty-eight pilots varying in flight hours from 200 to 2700 and from initial entry graduates to NOE instructors have been tested, over 10-12 flights each, in NOE mission planning, navigation and aircraft handling. A quantitative measure of mission success has been developed which correlates .8 with instructor pilot judgment. Mission success scores of relatively unskilled pilots is .57 (on a scale from .00 to 1.00), of NOE instructors it is about .80. Experience in flight at altitude does not generalize to NOE navigation, although aircraft handling experience does. This suggests that (1) flight training emphasis be placed on NOE navigation rather than aircraft handling; (2) training is required to bring average proficiency up to the .80 level.

Obstacle Avoidance Experiment. A study has been performed of the effects of obstacle characteristics, i.e., size, shape and closing velocity, on the pilot's ability to avoid these obstacles, as measured by reaction time and accuracy. Twenty pilots with varying levels of experience have been exposed to a video tape presentation of NOE flight. Results of the experiment are being analyzed.

NOE Task Analysis and Training. Because of the need to conserve fuel and reduce flight time, emphasis has been placed on determining how ground training (making use of dynamic visual aids) can be used to substitute for a maximum amount of flight training. (1) A preliminary experiment was performed at Ft. Rucker with static visual displays (slides) to teach terrain analysis which is critical to NOE navigation. Seven pilots were given a two day ground course and their performance in NOE navigation was contrasted with an equal number of pilots who practiced navigation in flight. There was evidence that ground training improved the ability to recognize terrain checkpoints. (2) A detailed analysis was performed of tasks required for NOE flight and recommendations were made for improving the training of initial entry rotary-wing students. A similar analysis is being performed of training required at operational units. A special terrain analysis training film and manual for map interpretation are being developed.

Synthetic Flight Training Systems. The first subsystem of the US Army's Synthetic Flight Training System (SFTS), device 2B24, was evaluated to determine its suitability for cost-effectively accomplishing certain phases of Army rotary-wing flight training and facilitating aviator proficiency evaluation, standardization, and flight training quality control. The device, which simulates the UH-1 helicopter aircrew workstation was designed specifically for these training-related purposes. A three-phase mission suitability test was conducted which examined the 2B24's advanced features in a training context, developed a new instrument training

program for use with it, and administered that training to a group of 16 volunteer officers who had completed Army primary rotary-wing training (100 hours), but who had neither any other prior helicopter experience nor any instrument flight experience. Results confirmed the device's mission suitability regarding both cost and transfer of training.

Major Thrusts

Pilot Performance Measurement. The over-all thrust of the Aircrew Performance Enhancement program is on empirical research. The measurement of aircrew performance in an operational flight mode is a central feature of all future projects in this area, and is itself a significant subject for research. This research breaks down into a subset of research projects, the first of which is the development of a performance assessment methodology without which further measurement is not possible. Most present methods of evaluating aircrew proficiency are subjective, non-diagnostic, of questionable validity and applied mainly in the training environment. The methodological research in this thrust area will center on the development of practical methods of assessing operational flight performance. It will involve the identification of key performance variables to be measured, the evaluation of alternative measurement methods and the selection of an optimal method. Research in this area has been performed by other services, but the special characteristics of Army helicopter flight (particularly at Nap-of-the-Earth (NOE) flight) makes it necessary to focus a specific effort on helicopter operations. A second research area which falls out of the preceding one involves the continuing measurement of the baseline proficiency of aircrews performing a variety of operational missions. This will provide "quality control" data to the Army which will demonstrate the Army's readiness to respond in combat. As part of this effort, research will be performed to determine how much proficiency is lost as a result of pilot lay-offs and the most effective means of maintaining proficiency and restoring it.

Flight Training Methods Research. This research area is concerned with flight training methods, which also includes ground training as applied to flight functions, e.g., navigation. Although flight training has been provided for many years, critical decisions with regard to the following questions are made without the benefit of empirical evidence:

a. How much training should be provided?
b. What is the most effective mix of air and ground training?
c. What methods should be employed in training?
d. In what sequence should various subject areas be presented during training?

Research in this area is all the more necessary because the next generation of aircraft and avionics systems will require highly specialized skills. For example, of all the areas of Army air-crew training, the greatest need for improvement is found in the area of NOE flight, which imposes severe burdens on the pilot in terrain analysis, navigation, obstacle avoidance, and target acquisition. Since the Army pilot will be required to fly at NOE altitude at night and under all-weather conditions, he will be given special sensor detection equipment (e.g., FLIR, LLTV) which will itself require him to have special training if he is to make effective use of these devices. Also, flight effectiveness depends heavily on what the student has learned in ground school. It is, therefore, necessary to determine those skills and knowledges that can be feasibly developed through ground school methods.

Flight Training Devices Research. The Army is presently expanding the number and variety of devices (ranging from the very simple to the most sophisticated flight simulators) in teaching or exercising student pilots. Research is therefore required to determine the optimal characteristics of these devices. Considerable research on this topic has already been performed by other services and the Army will make use of this background information. However, the Army has special problems in simulating helicopter flight, e.g., the simulation of the pilot's visual environment at NOE. The utilization of training devices is often such that in practice they provide much less training than they could, were they optimally employed. One aspect of flight training devices research will be to examine the training effectiveness of devices currently being used by the Army and to develop more effective ways of utilizing them.

Navy

Training Technology R&D for Navy flight training receives its support from a number of separate and distinct organizations. At one end of the R&D spectrum is the Office of Naval Research. This organization is concerned with 6.1 or basic R&D. As such, their R&D is seldom focused on a single area of future applications; but this does not mean applications have not been made to specific training areas.

The Navy Training Equipment Center (NTEC), in addition to serving as a procurement center for training devices, does carry on specific R&D programs in performance measurement, training methods, and device characteristics that directly relate to flight training. Emphasis has been placed on wide-angle-vision-training-device techniques. The initial development is a research facility to study training on a wide range of visual missions. It is believed that this work will facilitate the development of design criteria for future devices. Work is continuing on a program of research in adaptive training in which basic laboratory research findings are carried through applied evaluation on into operational settings.

Performance measurement research is centered both on system performance and operator input activity. Test and evaluation of an automated performance measurement system is underway in the NTEC research simulator.

Another research task in the area of equipment design that has direct application to flight training is an automated GCA controller which selects audio commands by the computer for specific deviations from a prescribed flight path.

A summary of related NTEC R&D projects that relate to flight training are shown in Appendix 6-2.

The Navy Aerospace Medical Research Laboratory (NAMRL) under the Naval Aerospace Medical Institute carries on a number of directly supportive programs that relate to selection, classification, measurement, and evaluation. Other tasks relate to air-to-air visual target acquisition and criteria for fleet effectiveness.

The Naval Personnel Research and Development Center (NPRDC) has identified a comprehensive program of research that will extend the technology base of training in many areas including flight training. In addition, NPRDC established an R&D applications group as part of their technical support program.

At the other end of the spectrum from ONR is another group, "Training Analysis and Evaluation Group" (TAEG). While this group is not supported by R&D funds and reports to the Chief of Naval Education and Training, it has been very productive in the improvement of training. TAEG relates to training R&D as a customer for its applications in the solving of real training problems. It is an interdisciplinary group and performs the following functions:

- Identify potential and on-going training problems
- Develop or improve training systems
- Translate R&D products into training practice
- Conduct economic analyses of training systems
- Further the state of the art in educational research, development, and technology
- Apply systems engineering techniques to training design
- Develop training management systems
- Serve as consultants

Specific program elements in support of Navy flight training are listed in Appendix 6-3.

AIR FORCE

All R&D in direct support of flight training in the Air Force is conducted by the Human Resources Laboratory (HRL) at their Advanced Systems Division (ASD) or the Flying Training Division (FTD). The ASD is located at Wright-Patterson AFB for coordination with other technology based groups. FTD is

co-located with a user at Williams AFB. Basic research related to flight training is carried on through a contract program directed by the AF Office of Scientific Research and AFHRL.

The mission of FTD is to improve the efficiency of pilot and navigator training in the United States Air Force. It has been in existence for about 6 years and is the only completely functional R&D unit in the DoD specifically and solely concerned with flight training. The emphasis in this unit has been, and will be for sometime to come, on the design and use of flight simulators, ground trainers, and part task trainers. The ASD function in the area of flight training has been supportive to FTD in the engineering development of simulators and in technique for automated performance measurement. A complete list of FTD research projects and reports is available in Appendix 6-4. The magnitude and location of the R&D effort in this area are shown in Appendix 6-5.

The FTD carries out a balanced program of R&D that relates to three levels of responsiveness. These are:

(1) Programs that permit a quick response to an existing problem area and usually resort to the adaptation of existing technology. Examples include the development and evaluation of a flight-line learning center and use of the simple General Aviation Trainer (GAT-1) as a device for early screening of pilot trainees.

(2) Programs that will require development support of several years, but for which the potential payoff is reasonably certain. Programs already accomplished in this category include the T-4G study for extending the training value of existing equipment through the adaptation of advanced training methods and the A7D project of enhancing the utilization of the A7D simulator through application of ISD methods.

(3) Programs of long range focus for improving the technology base. These include programs for ascertaining flight simulator design requirements and utilization methods that will achieve better and more useful understanding of the basic psychological processes related to flight training. The prime examples in this category are the studies utilizing the newly installed Advanced Simulator for Undergraduate Pilot Training (ASUPT). These will include tasks that examine questions relating to the cost effectiveness of specific simulator characteristics such as motion and visual capabilities, scope of training assignable to a flight simulator, instructional strategies, and performance assessment techniques. ASUPT is undoubtedly the most flexible and expensive device ever procurred for the explicit purpose of supporting flight-training research. While an exact figure is not available, procurement costs including the installation are on the order of $24 million. On the other hand, successful use of the facility should lead to billions of dollars in the cost savings or avoidance in future training costs and hardware acquisition.

6.7 ANALYSIS OF THE CURRENT R&D REQUIREMENTS PROCESS AND MANAGEMENT

The process of determining research requirements in support of flight training technology appears to differ for each of the services, but these differences are largely in the terminology. In each case the requirements generation process is well defined, coordinated between researchers and users, decisions or approvals occur at higher headquarters, and provisions are made for communications between the services.

Both formal and informal interservice reviews occur before a new training requirement is supported. Formal review is now implemented through the Interservice Research Exchange subcommittee of the Interservice Training Review Board. Informal review, of a more general nature, results from annual visits to other service laboratories, use of DDC information retrieval, seminars with interservice representation, coordination with Scientific Advisory Board activities, and other military and civilian R&D professional meetings and activities.

The Army primarily depends on an annual "dragnet" to identify human resource needs (HRN's) from which nonhardware R&D requirements are established. Once a year, all units in the Army are requested to submit statements of behavioral and social sciences research needs. As a result of the FY 1976 solicitation, 181 HRN's were submitted. For FY 1976, 91 HRN's were forwarded to DA for further evaluation. The remaining HRN's are transmitted to TRADOC for initial screening and then to the ARI for adoption in its work program. At the ARI laboratory level, each request is further reviewed and decisions are made concerning technical feasibility, appropriateness, and capability to perform the research. If accepted, these submissions serve as a basis for structuring ARI's research program. The entire program is reviewed by an Army R&D Advisory Board. Since ARI field units are co-located with operational groups, assistance is available to the operational commanders in identifying and structuring their research requirements as well as in helping the researchers develop their assessment techniques.

The review process at TRADOC identified the priority areas for FY 1975 as follows:

- Performance Training and Testing
- Simulation
- Recognition Training
- Training Literature
- ROTC
- ADP Technology
- Screening Selection Tests
- Feedback Data-Collection Devices

Training-device requirements are generated and processed in a different manner than the HRN's. If a requirement for a training device relates to a specific system, it is generated by the project manager (PM) of that system. It is processed by a special unit at TRADOC and procured by a special unit at the Army Materiel Command (AMC). A non-system device will originate at a TRADOC unit. In both instances, design requirements are expressed by TRADOC and modified by AMC on the basis of available technology.

In addition to the HRN approach to determining requirements for R&D, the Army convened a special conference, 27-29 November 1973, on an Aircrew Performance in Army Aviation. A product of this conference was a list of requirements neatly organized to form an integrated program of research. Four major areas were identified: (1) Performance Measurement and Evaluation, (2) Research on the Pilot, (3) Research on the Man-Machine Interface, and (4) Research on the Task Environment. The related subcategories outlined a respectable and comprehensive program of research. Detailed description of the program is published in the conference proceedings under the title "Aircrew Performance in Army Aviation," July 1974. Several of the subareas of the highest priority are being supported, but further approval is apparently needed before full implementation takes place.

The Navy establishes its research requirements through group interactions among operational and R&D personnel. Operational people define and describe problems and R&D people refine them and decide if, when, where, and how the research will be done. The requirements might come formally through an Operational Requirement (OR) process, through a Science and Technology S&T objective, or through procedures unique to separate research units such as the Office of Naval Research, Navy Bureaus, and Systems Commands. The OR is a concise statement of an operational need and is the basic document for programs requiring R&D support. The S&T objectives are reactive to Navy needs 10 to 20 years in the future, but for which research needs to be initiated immediately. Together, the OR's and the S&T's make up the Navy's R&D plan.

The Navy's system for generating R&D requirements in the area of flight training technology appears to be working quite well even though the supportive work is being carried on at a variety of agencies. R&D on training equipment is accomplished at NTEC; selection of pilots and performance measurement at Pensacola under NAMI; manpower, personnel, education, and training research, development, and testing at NPRDC, and basic R&D at ONR. Specific OR's or S&T objectives in support of flight training were not identified.

The Air Force procedures for establishing research requirements to advance flight training technology are quite similar to those used by the Navy. Major Air Force Commands, and, in particular, the Air Training Command, generate requirements for R&D related to flight training technology. Such requests are known as "RPR's" or Requests for Personnel Research, or "TN's," new Technology Needs. In most cases, the cognizant R&D organization will provide assistance to the commands in formalizing their requests. Other sources of R&D requirements include the R&D laboratories

where new concepts are developed that relate to future operational needs, from long-range planning groups and from System Project Offices (SPO's) and their Personnel Subsystem Planning Groups. However, all requests except TN's must be processed through the Air Force Deputy Chief of Staff for Personnel, Research Branch as specified in AFR-80-51. They then must go to the Deputy Chief of Staff for Research and Development, to the Directorate of Development and Acquisition of the Air Force Systems Command, and then to the appropriate laboratory.

Three regulations apply to the process of accomplishing R&D requirements identified for the flying training program. One is AFR-80-51, "Management of Research and Development Requirements in the Personnel Trainings and Educational Program." The second is AFSC Regulation 80-29, "Technology Need Program." The third is AFSC Regulation 27-5, "Engineering Services."

Research Branch of the DCS/P is responsible for the prioritization of RPRs. This prioritization is based upon the criticality of the R&D to the Air Force, the expected benefits of the R&D, the recommendations of the organization requesting the R&D, the relative importance of the R&D compared to other existing R&D requirements, and resources available. Inputs from other sources such as applicable Personnel Objective Management Officers (POMO's); the Air Force Deputy Chief of Staff for Research and Development, Directorate of Development and Acquisition; Air Force Systems Command; and the Air Force Human Resources Laboratory are solicited and used in the prioritization process. The categories established by Air Force Regulation 80-51, "Management of Research and Development Requirements in the Personnel, Training, and Education Program," are defined as follows:

> "a. Urgent. Offers major benefits to the Air Force; an early solution to the problem is an important factor in the requirement; there is high level interest in the work.
>
> "b. Priority. The proposal offers appreciable benefits to the Air Force and should be actively pursued; the work can be phased over a period of time.
>
> "c. Routine. The proposal offers benefits to the Air Force; the work should be pursued when resources are available."

The formal procedures for establishing R&D requirements seem to work quite well, from management's point of view, but the long channels for approval work against achieving an optimally responsive R&D capability. In many instances, the long delays between the initial statement of an R&D need and initiation of work brings in new people whose level of interest may be quite different from the initiator. Another problem is that the screening process for establishing R&D requirements, utilized by all the services, permits selective elemination of work that might produce results

counter to parochial interests, be disrupting to established ways of doing things, or threatening to the existence of sacred cows. The history of R&D on flight simulation substantiates this possibility. Both the Navy and the Air Force initiated exploratory programs on the expanded use of flight simulation for training in the early 1950's, but failed to follow through because of negative attitudes held by operational personnel regarding tradeoffs between simulator and aircraft time. It was not until the early 1970's that interest began to shift when the Army, through HumRRO, demonstrated that great cost savings and improvement in quality could be achieved through intensive use of advanced flight simulators. Of course, the great successes of the airlines in their use of flight simulation was an even earlier attention getter, but their training program was considered to be too different to permit relevant comparisons. Probably the fuel panic and the dollar crunch rather than all the available evidence explains the present support for simulators. Again, it is interesting to note that many of the advances in the use of flight simulation by both the Army and the airlines had their origin in the R&D work reported by the Air Force and Navy in the middle 1950's. The validity of simulation for supporting military aviation can be substantiated on the basis of efficiency, effectiveness, and product improvement and does not really need a fuel and dollar shortage to support it.

Another deficiency is that the strong influence of immediate operational needs tends to make most R&D programs reactive to current instead of future problems. Operational personnel have little interest in research that requires longer times than their own tour of duty. The penalty for a major emphasis and support for short-term studies is that the pool of new knowledge in training will lag behind new development in hardware and system technology and tend to concentrate on incremental improvements and refinements of existing methods and concepts.

Lastly, it appears that the present requirement-generating process does not provide for the use of outside groups to conduct unbiased evaluation of existing methods and procedures as a practical approach to the identification and formulation of new training needs. The potential value of this technique can be illustrated by a case history: About ten years ago, American Air Lines hired Arthur D. Little Company to conduct an independent survey of their pilot training program and to make recommendations for new training requirements. On the basis of their analysis of American's training costs, management procedures, and training methods, an entirely new and innovative training program was recommended. It made recommendations for the largest single investment in facilities, simulators, and other training devices ever made by an airline. When implemented, it became a model for airlines all over the world because of its cost savings, acceptance by pilots, and the improved performances of its flight crews. Such a program would not have developed if it depended on the insights and convictions of the management staff responsible for the training program existing at the time of the study.

6.8 TECHNICAL AND ADMINISTRATIVE CAPABILITY IN TRAINING TECHNOLOGY R&D

An adequate technical capability to do R&D in the general area of flight training resides in all services. However, the Air Force has the predominant potential because of its expansive and dedicated facilities, co-location with a user, and a centrally managed program. The Army is presently undergoing a transition from a HumRRO research organization to the ARI program, and has yet to replace the capability it has lost as a result of this change. The Navy effort is dispersed in several separately managed organizations.

As an overview of all services, flight training R&D management appears to be too distant from the users of its products to assure timely and cost-effective applications in a consistant manner. While coordination appears to exist in establishing research requirements, it is not so apparent in the application stage. The use of liaison type representation stationed at the headquarters of operational and training commands to "sell" R&D products would facilitate the applications task.

Most of the related R&D recently accomplished had as its objective the improvement of existing training programs with little concern or questioning of the validity of the programs being improved. However, recent efforts have been initiated by the Navy to reexamine the responsiveness of their flight programs to the operational requirements, and by the Army to improve the operational skill of Nap-of-the-Earth flight.

All three services report about 80 per cent of their R&D effort in flight training is in response to formal requests and 20 per cent for technology development. None of them report the existence of R&D requirements that are not being serviced, but ARI is still awaiting approval and support of an integrated and comprehensive program earlier defined. Again, they all report that close cooperation with user groups provides the cognizance of the operational environment necessary for effective R&D.

6.9 APPLICATION AND IMPLEMENTATION OF FLIGHT TRAINING TECHNOLOGY R&D

All military R&D at the 6.2 level and up has an applications objective. If the R&D is successful and shows promise for substantive gains when applied and if the financial support is available to implement it, then one could reasonably expect that it would be introduced in the operational world. Unfortunately, and for some perfectly legitimate reasons it may not be introduced; or it may not be introduced because of some less than legitimate reasons.

In the first category are things that relate to the uncertainty of downstream effects--a change in the requirement or the unavailability of support facilities or personnel. In the latter category are the real problems. When R&D applications do not occur because of the researcher's failure to sell his product, or when traditional and institutional biases of the user get in the way, or when conflict of interests is involved, management changes are clearly needed. But when R&D is accomplished,

that did not consider support costs and changes that would be required to implement positive findings, the deficiency must be placed directly on the R&D planners.

All of the services have provided examples of cost saving R&D applications and promise of more in the near future. These are good and substantive, but none of the services admitted to failures in implementation. Yet, enough examples are available, and one is described below to suggest that a serious problem does exist.

In 1964, a recommendation for the improvement of UPT was made by an ATC Training Wing Commander relating to the use of airborne video recording system (AVS). Working in close coordination with R&D personnel, the AVS was supported with 6.2, 6.3, 6.4, and later Initial Operational Test and Evaluation funding and manpower. Throughout its development cycle, the program was spurred on by favorable test results. Finally, procurement funds of $4.8 million were allocated. Just prior to complete procurement, the project was cancelled by ATC headquarters for budgetary reasons. The cancellation costs of the project were about equal to the dollars saved and thus the only savings realized were in downstream maintenance costs. But, the greatest loss was in the 10 years of R&D effort involved in the project and the opportunity to evaluate a new training concept that had progressed through a complete development cycle in an operational training environment. Of special interest here is to note the relative simplicity of the cancellation process and the lack of coordination with the R&D group responsible for its development.

The R&D implementation process is viewed as an important part of the research process by all services. Consultation activities of R&D personnel provide a major opportunity to transition laboratory findings to field use. The requirements process in all services are structured to assure implementation through a clear statement of user needs and the early involvement of the user in the R&D process. The publication of Technical Reports, and direct briefings to the user also serve to move information and techniques from laboratory to field. In general, more and more emphasis is being given to the importance of the implementation process and task scientists in all services are encouraged to recommend, demonstrate, and participate in application of products.

Effective in November of 1974, NPRDC established an R&D Applications Group as part of its Technical Support Program. The mission of this group is stated as follows:

> The mission of the Applications Group has as its focus, to facilitate the introduction of R&D end-products into operational use; to determine why R&D findings were not used, and if they can be modified to enhance their utility; and to develop new methods and techniques for R&D disemination and utilization. Although at this point in time the Group is quite small, a significant amount of progress has been made along a number of dimensions.
>
> " The following actions have either been initiated, or are in the process of initiation:

"1. Five major end-products have been selected for case history study. Intensive analysis has been initiated in an attempt to produce realistic assessments of the reasons implementation efforts were successful or unsuccessful.

"2. Liaison and informal information exchange has been effected with counterpart groups in the Army and Air Force, and certain of their procedures are currently being evaluated for Navy feasibility.

"3. The group's in the process of coordinating and establishing procedures with CNT so that Education and Training R&D end-products can be more effectively implemented and utilized.

"4. Close cooperation with BUPERS personnel to insure that Applications-type considerations are made an integral part of procedures now being developed for presenting operational problems in manpower and personnel management to the R&D community for solution.

"5. Through the use of "stockholders" reports, flag notes and individualized presentations, we plan to make potential consumers, other than those for whom an R&D end-product was originally intended, aware of significant breakthroughs and high-interest products.

"6. Procedures are being formulated which allow the Applications Group early entry to the standard R&D life cycle, thereby being made aware of future mid and long-range end-products. This process will significantly enhance the potential for operational implementation.

"7. As a result of the progress reporting system being developed, R&D efforts being completed, and readied for operational utilization, are being identified. Several major projects will be selected and pertinent methods and techniques developed and applied to facilitate their transition into operational use. From the experience gained, more procedures for general applications will be formulated."

6.10 ALTERNATE APPROACHES TO FLIGHT TRAINING TECHNOLOGY R&D MANAGEMENT

The question of a lead service for flight training R&D has been examined and rejected in favor of the separate but cooperative and coordinated approach. While it might seem that the Air Force should be the lead service because of the availability of its ASUPT and its capability in a spectrum of R&D pertinent to the Air Force, Navy and Army flight training. Each of the services has specific problems unique to their mission. For example, Nap-of-the-Earth flying for Army helicopters has no counterpart in the Air Force or Navy. Carrier operations are unique to the Navy. But the most persuasive point is that effective flight training research requires co-location with the user and the acquisition of great familiarization with the user's world.

Also favoring the separate but cooperative and coordinated programs is the competition for excellence it engenders, and the stimulation of searching for alternate solutions. Evidences of greater interservice cooperation and coordination are developing as previously discussed but more intensive use of exchange personnel and co-sharing of expensive R&D facilities appears to be warranted.

6.11 ISSUES UNIQUE TO FLIGHT TRAINING TECHNOLOGY R&D

Flight training research has a history almost as long as the aircraft itself, yet many significant issues remain the subject of debate, with little or no hard data available to settle them. Questions of such a fundamental nature as how to measure the proficiency of a pilot, cost-effectiveness relationships of alternate training strategies, transfer of training effectiveness relationships as a function of simulation fidelity, and rules for shaping combat pilot skills remain to be answered. We are still searching for better methods of training and the full potential of flight simulation is not known. Yet progress has been made, and more information is available for the improvement of training than has been applied.

Perhaps the most unique thing about flight training is its successful resistance to change. For years the primary content of flight courses was related to the performance of maneuvers, with little evidence that the maneuver skills related to operational tasks. We have always progressed students up through a sequence of aircrafts that varied in complexity. For example, in World War II all our pilots were trained in primary trainer, progressed to a basic trainer, then to an advanced trainer, and finally to an operational trainer. Yet during the Korean War, the primary trainer was the same aircraft used for advanced training in World War II. Unfortunately, the literature does not contain a single study in which this progress in complexity is proven to be a cost effective stategy of training, yet we still train pilots in this manner.

With the advent of high fidelity simulation and 360° visual systems, one wonders what the optimal training strategy might be when such devices are readily available. Conceivably, astronaut-type training where saturation learning in a simulator for the operational vehicle occurs might be applied to flight training and prove to be very economical. Or, extensive use of low-cost aircraft trainers with operational transition via simulation might be the way to go. Other innovative alternatives await expression and tech-base R&D efforts.

The resistance to change and the will to keep things pretty much as they have always been in flight training is not all bad, for it reduces risks of accidents and unnecessary changes. What is truly difficult to comprehend has been the inertia of the system to respond to proven developments and the negative attitudes that still exist toward incorporation of tested changes that could provide needed gains in economy or efficiency.

The most immeidate answer to lower training costs does not seem to be a need for more R&D on methods or even to advance the technology base per se, but rather on how to implement what we already know. In several instances where this has been done, great savings have occurred. One example is the revision of the A7D pilot training where ISD concepts were used. In this case,

$43,000 was saved in the costs of training per student, and flight time was reduced 24 per cent in training aircraft and 31 per cent in support aircraft with no additional investment in equipment or personnel.

Developments for the improvement of training and reduction in cost of training navigators has occurred, and all three services have made some gains in their undergraduate pilot training programs. But, most of these latter changes have been to do as well as or better than the present at lower than present costs. Major changes in training strategy have not occurred, and the lack of objective quantifiable measures for assessing the validity of the training has made it difficult to prove a need for or the potential benefits of major revisions.

Other unique issues relevant to flight training can be seen as service specific. Each of the three services trains pilots, but program orientations differ. Graduates of the Army pilot training school are directly assigned to a combat unit where final transition to mission specific skills occur. In the Navy, pilots are early selected into one of three different training tracks that relate to future assignments. In the near future, the Navy will use a new low-cost turboprop training aircraft. At the completion of 65 hours of training in this aircraft, students will enter a special track for jet fighter, propellor support aircraft, or helicopter training. Upon receipt of their wings, as is currently done, the Navy graduate receives further training in Replacement Air Groups prior to assignment in an operational unit. The Air Force gives a common undergraduate training to all their pilots that is heavily weighted for the fighter assignment even though only 20 per cent of their graduates are thus assigned. The concept is that their graduates are universally assignable, but in fact it means they qualified for further training.

The impact of the interservice differences on R&D is simply that the R&D results must be interpreted or extrapolated with respect to service-specific training strategies. But whether or not the three different training strategies are uniquely optimum for each of the services is a question for further inquiry. While there is no doubt that the present pilot-training strategies have worked in the past, whether or not the new world of energy shortages, environmental concerns, inflationary pressures, and reductions in military budgets will permit the perpetuation of these training strategies is still another question. The sustenance of a viable military force will no doubt require great savings in training costs and the challenging of these and other traditional precepts is one place to look for potential savings.

In most programs of individual skills training, the training is structured to provide the trainee with the knowledges and skills to perform specific operational tasks. This is not quite the case in undergraduate flight training. As mentioned previously, undergraduate flight training is presently designed to give the trainee a general set of skills and knowledge that can serve as a foundation to the learning of mission-oriented skills. While the Army helicopter pilot training program comes closer to producing mission-oriented skills and the graduate is assigned as a copilot in an operating squadron, the question is frequently asked if the advanced training is simply deferred to the operational commands where training competence is not necessarily available.

Logic and experience dictate that basic skills should be acquired before complex ones can be efficiently learned. But whether or not the basic skills can be learned in an operationally oriented context to facilitate the learning of the more complex operational skills is yet another question yet to be explored.

The Air Force has completed a very comprehensive analysis of the flying skills common to most types of operational missions and has attempted to relate them to the UPT syllabis requirements. (Mission Analysis or Future Undergraduate Pilot Training: 1975-1990). While no substantive changes have as yet resulted from this analysis, supportive work in the application of ISD to UPT will lead to useful changes in the future.

Flight Simulation

A special discussion on flight simulation appears to be appropriate because of the great potential it offers for cost savings in flight training programs. The OMB, GAO and SAB have conducted separate studies on simulation that are quite specific as to the magnitude of the savings that should be achieved.

The Technical Director of the AF HRL's FTD, has developed a chronological list of simulator studies and research projects that summarizes the basis for much of our knowledge in this area and points out how long all this knowledge has been with us. (A copy is included in Appendix 6-6.) While most of the earlier studies were concerned with assessing the amount of learning transfer that occurred from a trainer to the aircraft, more recent studies by Caro and Hagin have been concerned with the development of methods for improving the use of flight simulators.

The recent enthusiasm for flight simulation has produced an uneasiness on the part of the R&D community that has been involved with the utilization and assessment of flight simulation over the years. It is well known that there are many questions that remain to be answered that could have a tremendous effect on procurement costs and the scope of training assignable to the flight simulator. For example, little is known of the kind and amount of motion necessary for pilot acceptance, to produce effective transfer in different flight regimes,and as it relates to levels of training, mission tasks, or its interactive effects with other sensory modalities. Little is known about the proper mixing of simulator and aircraft training, and we have little more than opinions on the best methods of using simulators in training. Furthermore, since we can expect that a larger proportion of combat skills will be taught in future simulators, we must find methods for the validation of simulator-acquired skills, for it is quite possible that unexpected side effects of such training, either good or bad, might inadvertently develop.

Another point of concern (more in the field of engineering but which impacts on training) is the lack of R&D support dollars to extend simulation engineering to reduce procurement costs, and the lack of developments in low cost part-task trainers to extend simulator availability. Also,

an Air Force analysis of the operational requirements for simulation as expressed by the using commands indicates the need for simulator capabilities not presently available.

Recent analyses conducted by the GAO indicate that a simulator could cost ten times the aircraft cost to be an equivalent investment. This is purportedly based on records that show a simulator can generate 3,120 training hours per year where an average training aircraft will be available between 275-350 hours per year or a productivity ratio of ten to one in favor of the simulator. However, the real ratio of productivity could be greater or less than this if measured in terms of the transfer effectiveness of an hour in the simulator as compared to the learning value of an hour in the air. Generally speaking, an hour in the simulator can be worth several hours in the aircraft in terms of the number of practice trials of interest that can be conducted in the simulator; so, the productivity ratio becomes less meaningful as an indicator of benefit.

Projections of some of the special committees on simulation envision as much as 50 per cent reduction in undergraduate flying training is possible by 1980 through the extended use of flight simulation and up to 25 per cent of all flying. Whether or not these projections are conservative or ambitious, there is but little question that the simulator will have an ever-increasing influence on the cost of developing and maintaining flight proficiency of aircrew people in all of the services.

There is a question of whether or not the potential of flight simulation will be achieved in a timely manner and whether or not sufficient RDT&E support requirements to bring all this about will be provided. Information on the latter question indicates that there has not been adequate funding support in simulation R&D to achieve the technical developments expected and sufficient manpower has not been allocated to ensure maximally effective utilization of what we already have in simulation and what we expect to get in the near future. In defense of this statement, it is interesting to note that for the last two years the contract program of the unit in AFHRL responsible for simulator engineering research has been zero funded.

Again, it is quite clear that the potential gains in cost savings and performance enhancement through more effective utilization of flight simulators is very large. It is also quite clear that there has been a great deal of attention given to the subject; but it is equally clear that the RDT&E support of flight simulators has not properly reflected the R&D still required in light of the critical dependence the services have assigned to simulators for meeting future training needs at all levels.

<u>Army Flight Training Equipment Utilization</u>

Recent studies in the use of simulators and other ground training devices in the military flight-training environment of the Army are summarized as follows:

In 1965, HumRRO established the design requirements for the Army's Synthetic Flight Training System (SFTS). The SFTS is designed around the premise that aircraft simulators should be flight trainers, not merely expensive representations of aircraft. The initial SFTS subsystem to be developed, Device 2B24, provides high-fidelity simulation of the UH-1 helicopter, although it is chiefly noted for its design-for-training features. These training features include provision for automatic performance monitoring, automation of a number of instructor functions, playback (in both real and "slow" time) of student performance, and modeling of idealized performance. When first developed, Device 2B24 was clearly the most advanced training equipment available for undergraduate and graduate-level pilot training. Several of its more advanced training features have been incorporated into simulators built since that time by the Navy, Air Force, and Coast Guard. HumRRO's continued involvement with the SFTS has included development of training programs for its use, as well as the design of subsystems of the 2B24 currently under development for the CH-47 and the AH-1 (TOW) helicopters.

The work with the SFTS has stressed the point that the simulators themselves, regardless of the number of training features they may contain, do not produce pilots. Rather, it is the manner in which the devices are used in conjunction with other available training resources, i.e., the total training program that produces pilots. Consequently, the SFTS (like any other simulator training device or equipment used for training) must be viewed as a part of an overall training system.

The UH-1 simulator portion of the SFTS, Device 2B24, was delivered to the Army Aviation School in 1971, and HumRRO developed an instrument training program for it and tested its suitability for Army undergraduate pilot training. The test demonstrated that Device 2B24, when used appropriately, could have a major cost impact upon undergraduate pilot training. The Army's instrument training program could be reduced from 60 hours in the aircraft and 26 hours in an existing training device to approximately $6\frac{1}{2}$ hours aircraft time and 43 hours in the SFTS, almost a 90 per cent reduction in the amount of flight time required to meet the instrument training goals. Although the test concentrated primarily upon the instrument training capability of the device, additional transfer of training benefits were noted in meeting visual flight training requirements. Even at 1972 costs, the per student savings resulting from instrument training with this device approached $5,000.

Although the benefits of SFTS training demonstrated by this test were consistent with the results of similar research elsewhere, the Army has been skeptical that such a large proportion of undergraduate helicopter pilot training could be accomplished through simulation. Its implementation of SFTS training, therefore, has been slow. Beginning with only $7\frac{1}{2}$ hours of simulator training per undergraduate student pilot, the Army has run a series of informal studies to verify the previous test results. Finally having become satisfied that a major portion of its instrument training requirement can be met through use of the SFTS, a program similar in several respects to that demonstrated in 1972 is to be implemented at

the Army Aviation Center in October 1975. That program, as presently conceived by the Army, will involve 20 hours of aircraft time and 40 hours of simulator time to achieve the instrument flight training objectives met through 60 hours of aircraft training prior to introduction of the SFTS.

While Device 2B24 already has proven to be a very cost-effective means of training for the Army, its full potential is far from being realized. To date, it has been assigned only one rather limited application--undergraduate instrument training. Other R&D efforts to determine the extent to which training goals can be achieved with this device have been proposed. These are described briefly below and should be supported as high priority projects.

Maximum Use of Device 2B24 in UPT. Although Device 2B24 has no visual display, many of the flight skills developed in it have direct applicability to a visual flight situation. It is probably that initial training in this device in a training program designed to optimize transfer to a visual flight environment could have a major impact upon present UPT aircraft training requirements without incurring the expense of visual simulation per se. One very real possibility is the complete elimination of the need for the present primary training aircraft, the TH-55. For over two years, HumRRO has been seeking Army support for R&D to determine the extent to which existing Army undergraduate pilot training requirements can be met through training in Device 2B24. The results of such R&D could have enormous economic pay-off not only in the Army, but also in the Air Force and Navy as these services acquire simulators comparable in training sophistication to the SFTS.

Use of Device 2B24 for Combat-Readiness Training. The Army has begun the installation of Device 2B24 at field units in this country and in Europe, where they will be used to assist in the maintenance of combat-readiness flight skills of assigned aviators. In 1973, HumRRO conducted an exploratory study using Device 2B24 to determine the extent to which aviators could rely upon training in the device as a supplement to or a substitute for training in aircraft to maintain critical visual and instrument flight skills. Although the number of aviators available to participate in this research program was limited at the time, it was found that proper use of the device could make a major contribution to the maintenance of required skills. In fact, it was found that aviators who were prohibited from piloting military aircraft probably could maintain acceptable piloting skill levels for extended periods through device training alone. If such results could be validated on a larger aviator population, the implications for the Army, as well as for the other services would be quite important.

Navy Aircraft Simulators

Chief of Naval Aviation Training (CNATRA), with the assistance of the Naval Aerospace Medical Institute and the Naval Training Equipment Center, has conducted an evaluation study of the 2F90 simulator for the TA-4J aircraft. The simulator has 3 degrees of motion freedom. Based on the result of this

study, flight hours in the TA-4J have been reduced by ten per cent. This amounted to dollar savings in the O&M budget of more than a million dollars in 1974.

Another study is in progress evaluating the 2F101 simulator for the T-2 aircraft. This simulator has 6 degrees of motion freedom, an advance instructor's station, and several other advanced training features. Preliminary experience with this trainer indicates substantive savings will likewise occur at this level of training.

The 1D23 is a navigation and communications simulator for the NFO program. It has 40 cockpits and is controlled from a central station by two flight instructors and two technicians. It is the first modern simulator designed for the NFO. It is presently undergoing extensive analysis by a HumRRO team that is conducting a comprehensive revision of the NFO program.

This work is being undertaken in two phases, the first of which is nearing completion and includes a detailed review of existing NFO basic training objectives and their restatement in terms more readily measurable. This review has resulted in some realignment to make the training more responsive to operational needs and to eliminate minor duplications among training activities. An interim report containing these revised and clarified objectives has been subjected to extensive review by the Navy and is currently being used as the basis for basic training program revisions. Course content responsive to these approved objectives will be reorganized where necessary to assure efficient course administration. As part of this program revision activity, an existing navigation training device, the 1D23, is undergoing extensive analysis to determine how it can best be used in meeting some of these objectives, thus possibly leading to a reduction in the amount of training which otherwise must be done in flight.

The second phase of the NFO training program revision project will be conducted during FY 1976. In it, the training program currently under development will be tested. Further work is planned during which the NFO specialty school training, the training received by NFO's upon graduation from Basic, will be subjected to revision and testing.

U.S. Coast Guard Use of Flight Training Equipment

Another very important simulator research study of relevance to DoD is a study recently completed by the U. S. Coast Guard that serves to illustrate the benefits which can be derived when advances in training technology are applied to a pilot training program. The USCG study was in response to the problem of maintaining high quality pilot training despite the increasing complexity of its aircraft and mission and rising costs. The work was undertaken by the HumRRO group from the Army Aviation School at Fort Rucker over a six-year period.

The work began with a study of the Coast Guard's operational mission and the design of a training system which would yield the required aviator skills through the cost-effective use of simulators, aircraft, and other training resources. Based upon an in-depth investigation of search-and-rescue mission requirements, a comprehensive set of training objectives was derived. These objectives provided a basis for the development of design and cost estimates for aircraft simulators and for the determination of which training objectives could best be met through simulator, classroom, and aircraft training. The simulators and training programs were then developed and installed at the Coast Guard's Aviation Training Center. These simulators and training programs, because of fortuitous project timing, made extensive use of information developed by HumRRO during its work on the Army's SFTS, and as a result, the Coast Guard's helicopter pilot training programs probably are the most comprehensive existing example of an application of training technology to a pilot training requirement.

The resulting training system, which became operational in September 1973, is impressive and fully justifies the care exercised in its development. In addition to increases in pilot proficiency when compared with graduates of the earlier programs, the new Coast Guard pilot training programs have resulted in a significant reduction in training costs. Much of the training previously conducted in aircraft now is accomplished in simulators. In one helicopter qualification course, for example, the aircraft training time has been reduced from 78 hours per aviator to about 36, and the calendar time from nine weeks to six.

The total cost to the Coast Guard of procuring the simulators and developing the training programs for use with them was, of course, substantial over the six-year life of the project. When the savings resulting from reduced aircraft training costs alone are considered, even that considerable investment was amortized in only 14 months. Even greater savings could be attributed to the increased availability of aviators for mission assignments resulting from the shorter durations needed for training courses, as well as to the beneficial consequences of reduced numbers of training flights.

The Coast Guard pilot training program development project has been quite successful. The fact that it was the product of the systematic application of training technology had much to do with its success. While the simulators are important, it is the manner in which they and other training resources are being used that made this project a success. The aircraft, the instructors, and the support personnel are all part of the instructional system. The emphasis throughout the project was upon finding a cost-effective solution to a training problem, not upon acquiring simulators per se. It is a good example of a well-conceived, conducted, and managed project involving cooperative efforts of a uniformed service and a knowledgeable contractor over an extended time period.

Simulator Utilization Studies

The Air Force has conducted a number of studies in simulation using existing equipment. The first of these was a study in which the T-40 instrument trainer was used as a screening device for predicting pilot attrition in UPT. The study showed that UPT candidates potential flying ability can be quantified in less than five hours of job sample task performance in an instrument trainer. A later study on the same subject used the very simple and low cost GAT-1 trainer. Utilizing optimal screening procedures, the study indicated that the use of the GAT-1, UPT attrition could be reduced between 22 per cent and 10 per cent.

Another study using an existing trainer was conducted with the T-4G. In this study, improved training methods were used with the device and tested in an operational application at Williams AFB. The result was a 43 per cent savings (8.9 hours) of T-37 aircraft time per student in the instrument training phase. The same methodologies were also applied in the T-38 phase of training using the T-26 ground trainer and 10.1 hours were saved there. If applied on a command-wide basis, these savings would total to more than $10 million per year.

In 1970, AFHRL's Flying Training Revision initiated a procurement request for the fabrication of a low-cost, very simple part-task formation flight trainer. In a series of evaluation studies conducted after receipt of the device, it was demonstrated that at least two aircraft training sorties can be replaced by training in the formation flight trainer without adversely affecting student training.

Perhaps the most important simulation development project initiated has been the Advanced Simulator for Undergraduate Pilot Training (ASUPT). The ASUPT is a direct product of a DoD guidance document of 1967 referred to as project "INNOVATE." The ASUPT was delivered and accepted at Williams AFB in January 1975. By mid-year it will be 70 per cent available for accepting R&D programs. While ASUPT represents an investment of about $24 million in hardware, it has been justified on the basis that only through the systematic control of simulator fidelity, that permits degredation from the highest possible level of fidelity to complete absence of fidelity, can the essential characteristics be determined by objective measurement and valid judgments made of the desirable degrees of fidelity required for different training tasks. The ASUPT will also permit research in training methods, pilot performance measurement, and interaction of sensory modalities not otherwise possible. The findings from ASUPT can have impact on the design and utilization of all future simulators to be procured by all services as well as on the curricula of flight-training programs.

Other advanced technology simulators recently procured by the Air Force include the Simulator for Air-to-Air Combat (SAAC) and an F-4 flight simulator with a visual attachment for teaching air-to-ground weapons delivery. Both of these units will be located at TAC's Luke AFB in Arizona. The potential value of these devices is hard to estimate since the future of air-to-air and air-to-ground combat can be affected by these devices. While it is

perfectly understandable that Tactical Air Command wants to initiate training with these devices as soon as possible, their application to support carefully conceived and planned programs of research to determine their full potential might be a better first level of application.

6.12 SUMMARIES OF INDIVIDUAL SERVICE FINDINGS AND RECOMMENDATIONS

ARMY SUMMARY

1. Finding

The Army has not been fully responsive in the application of the R&D it has sponsored in the area of flight training technology.

Discussion

In the past 20 years, R&D in flight training has been performed by a HumRRO unit at Ft. Rucker under Army sponsorship. During this time frame, important findings have been published relating to performance measures, procedure trainers, advanced concept flight simulators, and improved training methods. While some of the products have been applied, some have not and for many reasons.

The HumRRO R&D responsibility will be essentially terminated in pilot training for the Army in July, 1975. Their years of experience and familiarity with Army problems in pilot training will be lost except where they compete in future contracts and the opportunity for fully exploiting their findings may be lost.

Recommendation

It is recommended that the Army be tasked to obtain a review of the work that has been accomplished over the past 20 years with a reporting of all applications, areas where applications could have been made but were not, and where the final results did not merit application. Wherever possible, cost benefit data should be provided in the report. This report should be used as guidance for the development of the R&D plans of the in-house R&D unit being established at Ft. Rucker.

2. Finding

Furthur savings in flying time and cost savings appear to be feasible in the undergraduate helicopter pilot training program using existing simulation equipment.

Discussion

The recent study by HumRRO in which the Synthetic Flight Training System (SFTS) was evaluated indicated that 90 per cent of helicopter

instrument trainings could be done in the SFTS. Thus far, the program only permits 40 per cent substitution. Based on other simulation studies, it is quite likely that the SFTS could be effectively used in other phases of the undergraduate pilot training program as well with additional savings in costs and time.

Recommendation

That a directive be issued by TRADOC to achieve further savings in the instrument phase of undergraduate helicopter pilot training by working toward 90 per cent use of the SFTS. Additional flight training R&D should be initiated to determine the savings in flying time during the initial contact-flight training phase that could be achieved by extension of SFTS utilization to that phase.

3. Finding

The present program of R&D in flight training is concentrated on nap-of-the-earth (NOE) flying; it excludes nearly all other areas of helicopter flight training R&D.

Discussion

The Army has a very comprehensive program plan for integrated R&D to support helicopter training, developed by a very large conference in November of 1973* with talent from throughout the R&D community. As of yet, only a small part of this total program plan has been approved or initiated; namely, the work related to NOE flight and its performance measurement.

Recommendation

The Army should identify and adopt a long-range plan for helicopter flight-training R&D. The plan should show the relation of NOE flying R&D to other flight-training problem areas as identified in the program-plan developed in the November 1973 conference.

NAVY SUMMARY

1. Finding

In general, the Navy is aggressive in its efforts to apply new technology, but its R&D programs in flight training are too distinct, organizationally remote, or fractionated to be considered responsive by training commanders.

Discussion

The Navy's undergraduate pilot training program incorporates the

* Conference Proceedings, "Aircrew Performance in Army Aviation," Office of the Chief of Research, Development & Acquisition, November 1973.

use of advanced technology flight simulators, learning centers, a multi-track training system and the rudiments of self-pacing. Studies are underway to incorporate computer-controlled management, computer-generated visual systems, automated GCA, improved performance measures, and a task-relevant curriculum. Low-cost training aircraft are being procured to replace time in aircraft with much higher operating costs; yet interestingly enough, none of the implemented innovations is considered by the Navy training community to be an application of a specific R&D program. Rather, they are viewed as applications of advanced technology by the operating command.

Personnel at the office of the Chief of Naval Aviation Training (CNATRA) express a rather negative view concerning the history of contributions made by the research community to their programs. The one exception relates to work done by the Navy Aerospace Medical Research Laboratory in the area of selection and measurement.

Recommendation

Geographical colocation of R&D personnel on Navy Flight-training bases and incorporation of R&D staff representation in appropriate headquarters, development of a consolidated program of pilot training R&D and provisions for its central management are recommended. The fragmentation should be corrected with consolidation(s) into one (or two) flight-training R&D units located, as indicated, with major flight-training populations.

AIR FORCE SUMMARY

1. Finding

The undergraduate pilot training program of the Air Force uses a single track fighter-oriented training concept, although only 20 per cent of its graduates are assigned to fighter units.

Discussion

Experiences of the Navy, the civilian sector, and the air-arms of other nations indicate that considerable cost benefits can be realized from use of multi-track flight training. The Air Force has defended its single track system on the basis that its missions are varied and priorities change, hence the graduates from its pilot training program must be universally assignable. While this might have been a viable concept in previous years, it is very costly to maintain under present circumstances. Since the largest percentage of pilot trainees is assigned to the heavier, multi-engine type of aircraft where they will make gradual transitions from a co-pilot position to a pilot-in-command position, great cost savings opportunities appear to be possible in the training of this group if a multi-track approach is used during initial training. Moreover, the increasing costs and complexity of equipment and mission tasks of the fighter

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pilot suggest the need for even more intensive, comprehensive, and specific training. Specifically customized training for the fighter pilot could be afforded were this smaller group identified during the early phases of a multi-track system.

Recommendation

Multi-track flight training should be initiated by the Air Force. Where experiences or R&D funding are lacking, the appropriate AF Training Technology R&D agencies should be tasked to conduct the needed studies.

2. Finding

There have been nontrivial failures in the implementation of Training Technology R&D findings.

Discussion

Over the past 20 years, the Air Force has supported numerous R&D programs related to flight simulators, but applications of the findings from this work have been limited primarily by negative attitudes. However, it was not until the fuel crisis of 1974 (with associated budget problems) that increased emphasis was placed on the use of simulators in flight training and proficiency maintenance. A recent example of a dramatic failure to implement is the cancellation of the procurement of an airborne Audio-Video Recording System (AVRS) in the final phase of product delivery; there was essentially no cost savings in procurement funds, but a complete loss of any potential for use of the equipment.

Recommendation

Cost-effectiveness analyses and evaluations should be required prior to commitments to acquisitions, prior to cancellations of commitments to acquisitions, and as a means of providing guidance to both operational training commands and Training Technology R&D agencies regarding the areas of most likely improvement.

3. Finding

R&D funding essential to advance simulation engineering technology has been inadequate.

Discussion

At the present time, technology-base R&D responsibility for flight simulator engineering development has been assigned to the Advanced Systems Division of the Air Force Human Resources Laboratory (AFHRL). This arrangement couples training R&D personnel, who can identify future training requirements for flight-training simulators, with simulator engineering personnel, who can identify and advise the engineering development needed for future simulation. However, difficulties in obtaining authorizations

and appropriations for increased funding of exploratory development at AFHRL has severely restricted contract and in-house efforts in technology-base simulation R&D.

Recommendation

Although single program-element funding is currently being emphasized within ODDR&E, an exception should be made in the present case. A new program element for flight simulator development should be established.

6.13 CONCLUSIONS

1. Undergraduate Pilot Training (UPT) in all of the services continues to be a very expensive endavor, but with a great potential for immediate and longer-range cost savings. Immediate cost savings could be achieved by more effective use of existing simulators and trainers, by adopting improved training methods, and by incorporating task-oriented training syllabi. Further, R&D of a direct nature in areas such as performance assessment, identification of job-relevant skills, training methods, and concepts, training-equipment design and utilization, and management methods should be highly productive in future cost savings. Programs of R&D in most of these areas have been designed, but many have not been initiated.

2. Coordination of R&D on flight training between and within the services does not always take place at the working levels and places where mutual benefits could be achieved. This is in part a result of the services not having similar organizational structures for R&D on flight training. While a number of coordinating committees exist, effective spreading of the work may or may not occur. New and better methods are obviously needed.

3. Flight training R&D management appears to be too remote from either training or operational command headquarters (or both, in certain instances). If the R&D managers are too distant from the training scene, understanding of the environment, procedures, problems, and objectives of the training programs will be less than desirable in the establishment of priorities, approval of levels of support, and provision of proper guidance to the R&D program. Likewise, to the extent that flight training R&D units are permitted to be physically remote from the intended users of their products, so will the probabilities be low of their making significant and timely contributions to the users' programs.

4. Present methods for establishing, prioritizing, and processing R&D requirements for flight training leave much to be desired. Since there is no independent evaluation of service-specific requirements, institutional biases can filter out what might be a highly productive program.

5. The successful work of the Navy's Training Analysis and Evaluation Group (TAEG) has led to the application of advanced training technology to several flight training programs with concommitant savings of many millions of dollars and conservation of scarce resources. They incorporate the services of an interdisciplinary team capable of performing cost analyses in their restructuring of existing training programs.

6. A problem existing to a greater or lesser degree in all services is the dependance on favorable management attitudes for the initiation, support, and application of flight training R&D. It is not infrequent that programs of great potential are either ignored or successfully opposed because of institutional biases and opinions based on less than full relevant experiences. There is little doubt but that strong biases prevented the expanded use of flight simulators at an earlier date in the services. Perhaps because of the lack of a rigorous system that places accountability on the decision makers (and those assigned responsibility for management and supervision of R&D applications), it has been relatively easy to withdraw support of a program at almost any stage. Also, rotation of military personnel has had a profound and negative effect on the continuity of support to R&D and to its successful applications. However, since rotation is a major feature of career growth in the services, and since civilian influence is minimal in the area of military flight training, changes will be difficult to achieve other than through an educational and evolutionary process.*

7. R&D in direct support of UPT has been primarily concerned with the design and development of training equipment, with insufficient emphasis on the development of innovative concepts and strategies. Proper analysis of future training requirements has been slow in evolving, and most Training Technology R&D has been reactive rather than innovative. Again, the emphasis appears to be disproportionately focused on "how to teach" rather than "what to teach."

6.14 RECOMMENDATIONS

1. Flight-training programs and flight-training R&D of the four services should be closely coordinated at the OSD level. Simulator development and utilization should be monitored closely and cost-effectiveness analyses made of individual, crew, and unit flight training, with comparisons of alternate approaches (a) to flight training, (b) to the use of simulators and other advanced training technology in such training, (c) with comparisons of differnces among the services, and (d) between U.S. and foreign flight-training programs. A level of effort at OSD of between 2 and 4 professional man-years per year is believed necessary to accomplish these functions.

2. Establish a joint-service R&D capability colocated with the Air Force Tactical Air Command (TAC) at Luke AF Base for management and utilization of advanced-concept flight simulators, such as the simulator for air-to-air combat (SAAC) and the F-4 simulator with air-to-ground visual capability, both currently located at Luke AF Base. The exceptionally high capital investment and

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* For example, see the reviews recently requested by the House Committee on Armed Services in H.R. Report 94-199, "Study of Costs of Forms of Manpower," p. 75.

operating costs of these flight simulators that are uniquely suited for flight training R&D makes relevant and full utilization of such equipment a cost-effective management goal. The basic commonality of training and mission tasks in service flying make desirable the joint use of such facilities. Thus, similar organization, management, and the utilization should be planned, or where existing (for example, the Navy representation at Williams Air Force Base) should be continued, for all major flight-training R&D simulators and facilities such as ASUPT (Air Force), AWAVS (Navy), and SFTS(Army).

3. Colocate flight training R&D units with training or operational flying units and require representation of flight-training R&D personnel at the user command headquarters.

4. It is recommended that both the Army and the Air Force establish TAEG-type units.

5. All services should place the highest possible standards on the selection and assignment of training and training-R&D managers at all levels. The establishment of suitable pre-assignment training should be instituted to assist in the transition of line officers to becoming competent managers of training and training R&D, much as similar pre-assignment training is provided in the case of PM/SPO assignments. Further, where exceptional competence has been demonstrated, tours of duty should be extended without negative impact on the individual's career progression.

6. Devote a substantial proportion of flight training R&D funds to longer-range programs that deal with innovative concepts such as the development of (a) ways in which ROTC training might provide both wings and a commission at graduation, and (b) innovative uses of flight simulators so that civilian-trained pilots might be attracted in sufficient numbers and trained at dispersed sites in major cities by simulation to qualify for certain types of transition training beginning with their first day in the service.

CHAPTER 7

WEAPON SYSTEM TRAINING SUBSYSTEM DEVELOPMENT*

7.1 INTRODUCTION

A weapon system is an instrument of combat (such as an aircraft or missile) including all the related equipment, supporting facilities, and services required to deliver it to its target or permit it to be used in carrying out the mission for which it was built. During the early development of a new weapon system, work should be initiated to define the system's training subsystem, i.e., those categories of training (skills and equipment) required to support the weapon system. This should be an orderly process by which the tasks required to operate, maintain and control the system are identified, and by which plans are developed for acquiring the necessary skilled personnel to perform these tasks.

In its review of weapon system training subsystems, the Task Force chose to focus primarily on the current procedures used by (Army and Navy) Project Managers or (Air Force) System Program Offices (PM/SPO's) to identify, develop, and procure materials needed for training personnel in the operation and maintenance of major weapon systems. Specific attention was also given to the availability and use of training technology R&D to support the development of training subsystems.

7.2 SCOPE OF WEAPON SYSTEMS TRAINING SUBSYSTEM DEVELOPMENTS AND COSTS

The Task Force, in conjunction with representatives of the three military services, selected five weapon systems from each service for examination. The five systems were selected to represent the range of each service's activities in the area of weapon systems training subsystem development. The selected systems were:

Army:	TOW, M551 Sheridan, Dragon, Improved Hawk, OH-58
Navy:	F-14, S-3A, DD 963 Destroyer. LAMPS, Trident
Air Force:	B-1, A-10, Air Combat Fighter, AWACS, F-15

<u>Army Weapon Systems</u>

<u>TOW</u> - The funding history of the Tube-launched, Optically-tracked, Wire-guided (TOW) anti-tank weapon system and the training subsystem is given in Table 7-1. $4.6 million (0.4 per cent of the total budget) was devoted to training subsystem development, including $3.5 million (76 per cent for hardware and $1.1 million (24 per cent for manuals.

*O.S. Adams

M551-Sheridan - Because of incomplete data, no analysis of the funding history of the M551 Sheridan Tank could be made.

Dragon - From FY 1964 to FY 1974, overall funding for the Dragon anti-tank missile system was $109.4 million. $4.0 million (3.6 per cent) of the total budget was for the development of a training subsystem and $0.77 million (0.7 per cent) for operator and maintenance handbooks. Funding data are presented in Table 7.2.

Improved Hawk - Due to incomplete data, it has not been possible to obtain an accurate determination of the total cost of the Improved Hawk surface-to-air missile system. It is estimated that roughly 3 to 4 per cent of the RDT&E funds for FY 1963-FY 1972 were for the development of the TPQ-29 simulator and for new training equipment (NET). Approximately 3 per cent of the FY 1969-FY 1975 funds were for procurement of the TPQ-29 simulator and 3 per cent for the procurement of manuals (PUBS). Data provided to the Task Force on the system are given in Table 7-3. (The figures in parentheses indicate the percentage of the total program for that year.)

OH-58 - Funding data are not presented for the OH-58 Helicopter, since no funds were budgeted for its training subsystem. The Army stated that this was an off-the-shelf procurement, and that the aircraft were assigned directly to units in the field.

Navy Weapon Systems

The Navy failed to provide funding data pertaining to the training subsystems of the five selected Naval weapon systems. The Task Force was informed that the Navy has no systematic method to collect or compile such information, and no valid in-service requirement to shred out general-purpose vs. weapon-system specific training costs for the development and life-cycle costs of naval systems.

Air Force Weapon Systems

B-1 - The current program authorization does not include direct provisions for the B-1 bomber training subsystem. The only funds expended to date have been $70 thousand in FY 1974 to initiate an SAT/ISD study to define aircrew training subsystem configuration to meet those requirements. An additional $697 thousand has been added in FY 1975 to complete the study. It is estimated that it will cost $45 million for the development of the aircrew training subsystem and $80 million for the technical data such as operator/maintenance manuals.

A-10 - The funding history of the A-10 close support aircraft is provided in Table 7-4. It is estimated that the total cost of the system will be $2,833.8 million, of which an estimated $48.6 million (2 per cent of the total) is devoted to the training subsystem and $41.3 million (1.5 per cent) to maintenance and operator handbooks.

TABLE 7-1

TOW FUNDING

($ Millions)

	Fiscal Year														
	62	63	64	65	66	67	68	69	70	71	72	73	74	75	Total
Total System	2.2	7.9	18.5	22.3	25.6	14.1	6.0	2.1	2.2	1.3	1.1	.7	5.7	6.7	116.4
Trng. Subsystem	-	-	.15	.25	.20	.20	1.90	.90	.98	-	-	-	-	-	4.6
Hardware	-	-	-	-	-	-	1.8	.80	.88	-	-	-	-	-	3.5
Manuals	-	-	.15	.25	.20	.20	.10	.10	.10	-	-	-	-	-	1.1

TABLE 7-2

DRAGON FUNDING

($ Millions)

	Fiscal Year											
	64	65	66	67	68	69	70	71	72	73	74	Total
Total System	3.0	5.7	6.0	12.6	14.5	13.6	16.5	18.8	12.5	4.6	1.6	109.4
Trng. Subsystem				3.7						.2	.1	4.0

TABLE 7-3

IMPROVED HAWK FUNDING

($ Millions)

	Fiscal Year												
	63	64	65	66	67	68	69	70	71	72	73	74	75
RDTE	.09	1.3	.52	.44	.44	.45	-	.07	-	-	-	-	-
TPQ-29	(4.7)	(8.4)	(3.3)	(2.3)	(3.8)	(6.2)	-	(1.0)			-	-	-
NET	-	-	-	-	.07 (.6)	.02 (-)	.03 (-)	-	-	.05 (1.7)			
PEMA													
TPQ-29	-	-	-	-	-	-	2.6 (3.0)	2.0 (4.0)	2.8 (10.2)	1.5 (3.6)	1.8 (2.5)	2.2 (1.0)	.1 (-)
PUBS	-	-	-	-	-	-	-	1.0 (2.0)	3.1 (11.0)	1.7 (3.8)	.8 (1.2)	.1 (-)	1.5 (2.0)

*Figures in parentheses indicate the percentage of the total program for that year.

TABLE 7-4

A-10 FUNDING

($ Millions)

	FY 1974		FY 1975		FY 1976		FY 197T	
	DT&E	PROD	DT&E	PROD	DT&E	PROD	DT&E	PROD
System	107.4	-	81.4	166.9	51.9	360.7	1.0	87.0
Training	.2	-	.2	4.0	.1	22.2	-	-
Tech Data	1.8	-	4.1	5.3	1.1	5.0	-	2.1

	FY 1977		FY 1978		FY 1979		FY 1980	
	DT&E	PROD	DT&E	PROD	DT&E	PROD	DT&E	PROD
System	2.1	793.8	-	714.1	-	437.4	-	16.4
Training	-	30.3	-	33.7	-	32.0	-	16.4
Tech Data	-	12.1	-	11.5	-	3.9	-	-

	TOTAL	
	DT&E	PROD
System	368.8	2576.3
Training	.5	138.6
Tech Data	7.0	39.9

TABLE 7-5

F-15 FUNDING

($ Millions)

	Fiscal Year										
	69	70	71	72	73	74	75	76	7T	77*	Total
Total System	77.5	175.1	349.5	420.2	454.5	258.0	182.6	39.9	0	0	1957.3
Trng. Subsystem	0	.1	.1	.3	3.6	5.5	3.3	.3	0	0	13.2

* FY 77 POM funding level for the total system is $15M.

F-15 - Funding costs and estimates of the F-15 fighter and its training subsystem are presented in Table 7-5. The total cost of the system is projected to be $1,957.3 million (less POM 77 funding), of which $13 million (0.7 per cent of the total) is allocated for the training subsystem.

Air Combat Fighter - At the time of submittal of data to the Task Force, no funding requirements had been developed for the Air Combat Fighter (ACF) training subsystem. The ACF SPO stated that the funding requirements would be generated as a result of the cost estimates submitted with the contractor's proposals and an independent government analysis of these estimates.

AWACS - The funding history of the Airborne Warning and Control System (AWACS) was not provided. It is estimated by the AWACS SPO that less than 1 per cent of the total budget is devoted to training equipment development and approximately 0.2 per cent of the total budget will be required for maintenance and operator handbooks.

It is concluded that the development of training subsystem cost estimates is, at best, an imprecise process. There seems to be no standard procedure applied across the military departments to identify training costs nor, for that matter, among the PM/SPO's within a service.

Training subsystem cost estimates are generally not developed until a decision is made to order the weapon system into full-scale production. At that time, the PM/SPO depends primarily on contractor inputs and/or a factoring based on historical experience. The training-cost factor probably varies as a function of the type of weapon system being developed, the number of units being procured, and other variables that are peculiar to the specific PM/SPO or procuring service. For example, the USAF A-10 SPO reported the factor to be 2.5 per cent of the total flyaway cost; the AWACS SPO estimated it to be about 1 per cent of the total budget. The Task Force attempted to derive comparable factors from other programs, but failed primarily because the "accounting" procedure differed too greatly among these other programs. Adoption of a standard procedure would benefit future development of bases for factoring training subsystem costs of different types of weapon systems.

7.3 TRAINING SUBSYSTEM DEVELOPMENT PROCESS

Each of the three services has a well-documented process for developing the training portion of major new weapon systems.

Army

The procedures followed by the Army are prescribed primarily by AR 71-5, "Introduction of New or Modified Systems/Equipment," and AR 71-7, "Military

Training Aids and Army Training Aids Centers." The development of training equipment is initiated upon approval of the Training Development Requirement (TDR) which is a document prepared by the U.S. Army Training and Doctrine Command (TRADOC) containing the guiding factors (operational, technical, and cost information) against which developers and contractors meet the users' needs. During development and production cycles, periodic In-Process Reviews are conducted with all user elements to assure decision-makers that the item being evaluated will perform as intended and that it meets the criteria for reliability, availability, and maintainability as stated in the requirement document.

Navy

Two OPNAV Instructions describe the Navy's process for training subsystem development. These are: OPNAVINST 1500.8G, "Preparation and Implementation of Navy Training Plans for New Developments," and OPNAVINST 1500.11G, "Naval Aviation Training Program Policies, Responsibilities, and Procedures." The principal event in the planning cycle is the development of the Navy Training Plan (NTP). Planning for billets, personnel, and military-construction training resources, as well as planning for action to program, budget, and allocate resources, is formulated at an early stage of the new development by convening a Navy Training Plan Conference (NTPC). As the development progresses in detail and accuracy, the NTP is further refined and updated. For urgent developments such as Quick Reaction Capabilities (QRC's) or Rapid Development Capabilities (RDC's), planning for the training program may necessarily be compressed in time, participation, and documentation, but cannot be omitted.

Air Force

AFR 800-15, "Human Factors Engineering and Management," establishes the policies and responsibilities for incorporating the human engineering, biomedical, manning, test and evaluation, and training aspects of human factors into the mainstream engineering and program management effort of all Air Force acquisition programs and conceptual studies. It spells out the objectives and responsibilities associated with each of the Human Factors Engineering (formerly referred to as the Personnel Subsystem) elements, one of which is the Training Element. The latter incorporates, as a minimum, the trained personnel requirements, training plan, training equipment development, training, training support data, and training facilities. All components of this element are to be defined, designed, procured, or conducted based on (and justified by) a task analysis of system requirements. Additional guidance with respect to training equipment and related support is provided in AFR 50-48, "Management of Training Equipment."

7.4 PROCEDURES TO ESTABLISH TRAINING REQUIREMENTS

Until the past few years, there was no standard procedure or methodology

for generating training requirements information during the course of weapon system development. During the late 1960's, however, the Air Force undertook to develop a Systems Approach to Training/Instructional System Development (SAT/ISD) concept. This approach is intended to provide a deliberate and systematic process for planning and developing an instructional program to ensure that personnel are taught primarily the knowledges and skills essential for successful job performance. If an item of information or a skill cannot be related directly to mission performance or is not needed in order to acquire skills required for mission performance, it will either not be included in the training program or, if included, will be relegated to a subordinate role in training.

The SAT/ISD process is also supposed to provide for timely identification of the appropriate cost factors and to reduce the risk of buying or "overbuying" equipment not specifically suited for the training task. It was observed, for example, that in dealing with solutions to training problems, there is a distinct tendency for planners to emphasize training devices (hardware) to the near exclusion of other resources such as technical data, manuals and handbooks, content, and procedures or methods of training. Whether this bias reflects a priority established by preference or by demonstrated effectiveness is not clear. The Task Force was not presented with any quantitative data to substantiate that the selection was the most cost-effective one.

All three military departments state rather firm commitments to the SAT/ISD approach, but to date the approach has not met with complete success and acceptance. At least two PM/SPO's have experienced problems in lack of timeliness: (a) The A-10 SPO reported that it was not possible to use the SAT/ISD process in determining the type, complexity, and amount of maintenance training equipment required by his system because of lead times associated with the design, manufacture, and delivery of this equipment. That is to say, input task-analysis data were not available early enough to permit use of the SAT/ISD process in the design of the A-10 System. However, the process is expected to be used downstream to structure the field training-detachment curriculum and to validate the training equipment package. (b) The AWACS SPO questioned the benefit of applying the SAT/ISD approach in the development phase of a weapon system because of the difficulty (or impossibility) of obtaining useful and valid task analyses of operational and maintenance positions prior to adoption of relatively firm system and subsystem designs and maintenance concepts for the system.

Since many of the current weapon system developments have followed a course of demonstrational prototypes, with emphases on performance and on minimum acquisition costs, it is not unusual to find that program authorization does not include explicit requirements or funding for the development of training subsystem data. An exception to this is the B-1 program which will provide the first SAT/ISD application to an aircraft not yet in production as well as one of the first Air Force applications to a multiplace aircraft. The B-1 SPO contracted \$70 thousand in FY 1974 and \$697 thousand in FY 1975 for an SAT/ISD study of aircrew training requirements, equipment,

costs and schedules. The stated purpose of this effort is to investigate the possibility of completing a major portion of B-1 transition and recurring proficiency flying training through groundbased instruction and simulation in lieu of actual flight. In parallel with the contracted study, the Air Training Command is conducting an in-house SAT/ISD study of B-1 maintenance training-equipment requirements. The B-1 SAT/ISD studies should be followed closely for they could serve as models for similar efforts on future programs.

7.5 PROCEDURES TO ESTABLISH MANPOWER REQUIREMENTS

Because manpower requirements (e.g., number, availability and skill mix) impose certain constraints (e.g., utilization, effectiveness and cost) on a weapon system, the Task Force was interested in ascertaining whether any new or improved methodologies or techniques are being developed to replace or enhance the Qualitative and Quantitative Personnel Requirements Information (QQPRI) approach. For the past 10 or more years, the QQPRI has served as the fundamental manpower document to provide the gaining command with a basis for establishing manpower requirements (particularly maintenance) for a new weapon system.

Although the QQPRI approach represents a considerable improvement over previous methods for obtaining this type of information, it still has some shortcomings. Since it is not developed until after hardware design has been finalized, the QQPRI cannot be used to provide input to the design-decision process. For this reason, system-design tradeoff studies do not include valid manpower estimates. Further, being a contractor-prepared document, the QQPRI is often based on assumptions that are inconsistent with the manner in which the gaining command plans to operate and maintain the weapon system. The document has also been criticized as lacking flexibility (e.g., it treats only one given situation so that changes in the operations or maintenance environments may make it invalid), and as reflecting only a part of the manpower costs (e.g., it deals with the actual "hands on" time, with no specific accounting of set-up time, to-and-from transportation time, or supervisor and overhead requirements.

The Task Force was pleased to learn that the Air Force Human Resources Laboratory (AFHRL) had recognized the inadequacies in the QQPRI method and had begun in 1971 to develop a new technique for estimating and controlling maintenance-manpower requirements. The approach is based on computer simulation and employs the previously developed Logistics Composite Model (LCOM) that had been successfully used in several Tactical Air Command studies.

As described in comments and documents submitted to the Task Force, the LCOM provides realistic estimates of manning requirements and focuses on how both the weapon system design and operational procedures contribute to maintenance cost. The model is characterized as both dynamic and sensitive, with a capability for rapid updating and investigating the impact of

a wide range of system design, support, and operational alternatives upon manning requirements. It was developed for use by the A-10 SPO, and is now being applied on the F-16 program and the Digital Avionics Information System (DAIS).

With regard to the resources needed to apply the LCOM to a new weapon system, AFHRL estimates that it will require an interdisciplinary team of 6 to 8 people for a period of 4 to 6 months, depending on the developmental status and complexity of the weapon system. The computer costs, from first data bank run through the generation of a manpower matrix, are estimated to be approximately $27,500 in 1974 dollars.*

7.6 TRAINING TECHNOLOGY R&D SUPPORT OF WEAPON SYSTEMS

One of the concerns of the Task Force was the extent to which the service R&D agencies regularly support the training technology needs of weapon systems under development. Although only a few were mentioned, each of the services identified some R&D efforts that were being performed in support of some new weapon systems.

As examples, AFHRL reported the development of a functional integrated-systems trainer for the AC-130 gunship program, a fire-control system trainer for the F-106 fighter, and (as described above) the maintenance-manpower predition model for the A-10 close support aircraft.

The Navy Personnel Research and Development Center (NPRDC) stated that it has management responsibility for the development and delivery of both individual and team training packages for four aircraft systems: the S-3A, P-3C, S-H2, and F-14.

The Army Research Institute for the Behavioral and Social Sciences (ARI) pointed to its evaluation of the Multiple Integrated Laser System (a concept to train troops in a variety of direct-fire weapons) as an example of R&D support in assessing the state of the art in training technology. ARI is also working with the Army Tactical Data System's (ARTADS) PM to develop techniques to embed training subsystem packages within the operating system. The system could then be employed to teach the operator how to use the system.

In most of the instances of current weapon system development, the training technology R&D community seems to be involved only when a "problem" has been recognized. However, in many cases the problem recognized by the training agency, the user, or the PM/SPO could have been avoided had

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*Based on costs of previous QQPRI's of similar systems, the Air Force estimates that had a QQPRI document been developed for the A-10 system, it would have cost approximately $500,000.

the R&D agency been more closely coupled earlier in the development cycle. Stated otherwise, earlier involvement of the R&D community would provide it an opportunity to identify likely training and manpower problems and to undertake the necessary R&D to solve them where adequate solutions are not already available.

The Task Force did not find clear-cut examples of hard data and analyses produced by the Training Technology R&D community to influence PM/SPO decisions. On the other hand, there is little or no evidence that the necessary incentives exist within the system to lead the PM/SPO to attend to such data and analyses even if they were available. In fact, the incentives probably operate in the opposite direction. The PM/SPO job is to develop a new weapon system on schedule and to keep within the current fiscal-year budget. Any innovative applications of training technology that might have an adverse impact on current development costs and/or schedule are likely to be rejected, even though their results might reduce total life-cycle personnel requirements and costs.

7.7 CONCLUSIONS

1. During the early development stages of a new weapon system, work should be (and is supposed to be) initiated to define the system's training subsystem -- i.e., those categories of training (skills and equipment) that are required to support the weapon system. This is supposed to be an orderly process by which the tasks required to operate, maintain, and control the system are identified, and by which plans are developed for acquiring the necessary skilled personnel to perform these tasks. What should happen seldom does happen, and there is a clear need for a common methodology that provides visible and reliable estimates and accounting of weapon system training subsystem costs.

2. The training subsystem's impact on total life-cycle costs of the weapon system should be computed on a continuing basis, especially during the earlier design and development stages so that appropriate design tradeoffs can be made to reduce the system's total life-cycle costs. However, current requirements do not provide sufficient incentives to the PM/SPO to give appropriate consideration to training requirements and analyses early in the system-development process. In addition, a positive mechanism or directive is needed that will ensure the development by the Training Technology R&D community of comparative, quantitative analyses to support weapon system training subsystem decisions.

7.8 RECOMMENDATIONS

1. Task appropriate DoD agencies to develop a common methodology that will provide visible and reliable estimates and accounting of weapon system training subsystem costs. The techniques should permit decision makers to evaluate the impact of these cost elements on the life-cycle operating costs of the weapon system.

2. Develop and collate those data and costs associated with the planning and implementation of the training subsystem portion of weapon systems typically assigned to each of the services. These data should be organized (e.g., cost-estimating relationship) with the view that they are to be furnished to planners and designers (both military and contractor) for use in trade-off analyses, evaluation of alternative designs, cost-effectiveness analyses, and computation of life-cycle costs.

3. Incorporate subsystem requirements and planning (e.g. SAT/ISD) as a specific requirement of the DCP/DSARC I and II process and review.

4. Designate within each Military Department a portion of the appropriate R&D agency's effort for R&D related to innovative application of training technology that would reduce weapon system life-cycle costs and make more efficient use of system manpower. Funding of the R&D effort should be on a cost-reimbursable basis paid by the PM/SPO. A joint planning and approval process involving both the PM/SPO and the R&D agency should be developed for all Training Technology R&D programs funded under such an arrangement.

CHAPTER 8

CREW/GROUP/TEAM/UNIT TRAINING*

8.1 INTRODUCTION AND DEFINITIONS

The area of Crew/Group/Team/Unit specialized skill training, which hereinafter will be called CGTU training, is the transition zone between individual training and combat. It is the general practice in the services to accomplish CGTU training in operational units, and for the conduct and outcome of the training to be the responsibility of unit commanders, under the supervision and guidance of higher echelons of command. One result of this is that CGTU training costs and student loads are not readily available, having in the past customarily not been included in the DoD Military Manpower Report. Nevertheless, some idea of the scope of this training in just one Service, the Army, can be gained from the following tables, furnished by the Combat Arms Training Board (CATB), Department of the Army. Also, some incomplete data bearing on the scope and kinds of CGTU training in the services are presented in Section 8.2 of this chapter.

The Army comment on the data in Tables 8-1 and 8-2 is as follows: "The point is, in each location, the unit spends the larger part of its time performing collective training. Although this is a rough estimate, experience indicates that the relationship shown here will stand up to close analysis. The dimensions of the problem are further explained when one acknowledges the number of collectives which must be trained. Shown in Table 8-2 are the number of infantry, armor and field artillery units which must be trained collectively until they achieve the precise execution of a football team. When one recognizes that each of these organizations is spending the majority of its time on collective training, and that it requires its own separate training program, one sees how large the problem is."

Other significant dimensions of the problem are that CGTU training is the end-of-the-line preparation for combat. It is in the hands of Force Commanders (with the exception of some transition training squadrons in air crew training) who have other responsibilities and missions to fulfill that may conflict with the training mission. This training is far more difficult and costly to do than is individual training. Many teams are part of or use very expensive weapon systems. Training must be done in the operating environments, or in reasonable simulations of them. Control over training processes and training outcomes is immensely more difficult and less certain than for individual training.

Yet, this is the arena in which collectives of men are prepared for combat. Because the pace of modern warfare can be extremely fast, as demonstrated by the last two Middle East conflicts, it can be said that the next war may be won or lost on the basis of the adequacy of CGTU

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*Joseph Rigney

training. The young men coming out of the service academies or the various ROTC and OCS programs are trained only as individuals. So are the enlisted men graduated from the myriads of individual training schools. Since the principal purpose of the military is to act as a deterrence to war by being fully prepared to fight, or to win a war by fighting, it is obvious that CGTU training should be receiving the most careful consideration.

TABLE 8-1

ANALYSIS OF PERCENTAGES OF TIME SPENT IN INDIVIDUAL AND COLLECTIVE (TEAM) TRAINING BY TWO RIFLE COMPANIES

	Rifle Company from	
	82nd Abn Div	4th Mech Div
Training Activities		
Individual Training	11%	16%
Collective Training	50%	50%
Other Activities	40%	34%

Source: TRADOC, U.S. Army

TABLE 8-2

THE NUMBER OF INFANTRY, ARMOR, AND FIELD ARTILLERY UNITS WHICH MUST RECEIVE TEAM TRAINING

	AA	RC
Inf Bn	94	128
Rifle Co.	282	380
Rifle Plt	846	1171
Rifle Squad	2538	3450
Wpns Squad	576	740
81 Mortar Plt/Sec	94	377
81 Mortar Squad	282	1131
Hvy Mortar Plt	137	125
Hvy Mortar Squad	548	500
At Squad	526	750
Tank Bn	43	45
Tank Co	139	135
Tank Plt	417	405
Tank Crew	2085	2430
Scout Plt	43	45
Scout Squad	344	360
Hvy Mortar Plt	43	45
Hvy Mortar Squad	172	180
Fa Bn	76	113
Fa Firing Btry	230	353
Howitzer Section	1242	1944

Source: TRADOC, U.S. Army

Note: These are the numbers of CGTUS which must be trained "until they achieve the precise execution of a football team." Training loads (numbers of personnel undergoing training at any one time) would vary, depending on factors such as rotation, reenlistment rates, etc.

Two points are believed to be significant here. First, there is a technical and potentially costly distinction, obvious in the services' responses to the Task Force questions, between formally recognized, individual training in schools, and CGTU training conducted by the operating forces. The services tend to put CGTU training in different organizational and budgetary categories from individual training, which opens the possibilities for extensive discontinuities in the interfaces between the two, and for treating CGTU training as on-the-job learning that will occur automatically during operations. Secondly, the amount of R&D funds allocated to CGTU training research is, judging from service responses, relatively small. The Task Force must conclude that either the services already know how to do CGTU training most effectively and have no need of R&D or that this is a neglected R&D area. The evidence advanced by the TRADOC Commander (Army), regarding such matters as actual team proficiency versus that imagined by unit commanders leads to the disquieting conclusion that CGTU training is not always done well. If so, there are two important questions to answer. First, is the question of the readiness of the services to fulfill their principal reason for existence. This question cannot be answered directly, short of real test, but answers can, and should be approximated as nearly as possible by those responsible for answering. This is beyond the mission of this Task Force, but it is so central an issue, survival or not being the consequence, that it should be continually addressed by those assigned this responsibility.

The second question pertains to how combat readiness can be bought for less cost. This question is relevant to the mission of the Task Force. It must be made clear from the start that the answer to this question is nonobvious; the possibilities of training technology reducing costs of CGTU training and improving team effectiveness are speculative without R&D in which different alternatives are tried under conditions which permit comparative cost-effectiveness analyses. The complexities and uncertainties of alternatives that might be made available by training technology demand empirical investigations and quantitative data. Such data, with a few tentative exceptions, are not available for CGTU training A major source of data could be in the substitution of simulators for aircraft crew training. In the main, this alternative is just now being seriously entertained in the training commands, and the question of transfer of training or more properly, percentage of skills needed in combat that can be taught by air-crew simulators, has not yet been definitively determined, despite promising research done some years ago on alternative methods of training B-52 crews. The degrees to which training technology can reduce the cost of CGTU training cannot be specified in any general way today. Such a specification will be hard to come by at all, and will require some years of R&D attention to the problem even for partial answers.

Before turning to other questions in the charge to the Task Force, some consideration of definitions is in order. (The awkward term, CREW/GROUP/TEAM/UNIT, is used in deference to differences in terminology among the services.) For example, the Army tends to apply the term

"collective" to groups of men, and to training administrated to groups of men organized as teams. It is clear, of course, that there must be a number of different kinds of CGTU's in the services. The difference between a CGTU and a group of individuals assembled in one place, each doing an individual job, lies in the dependence of the CGTU's attainment of its objectives on communication and coordination among individuals in the CGTU. This dependence can take many forms, depending on the kinds of tasks the CGTU's are performing and on how they are organized, among other things. Verbal communication can involve exchange of tasks-relevant information, or can occur at a meta-performance level, where it is concerned with monitoring, coordinating, error-correcting, and the like. The media for verbal communication can be varied, and it can be encoded to a greater or lesser extent in special syntax. Or, the communication may not be verbal at all; it may be the appearance of cues in the situation that trigger cooperative efforts whose appearance or nonappearance at the expected times give each individual coordinating feedback.

Teams may be, and indeed are, organized hierarchically into complexes that ultimately include the executive and legislative levels of the government. These complexes also require training, although the costs of training these larger collectives tend to be prohibitive. A description of some of these higher order complexes in the Navy is found in the following section.

8.2 SCOPE OF CGTU TRAINING REQUIREMENTS

The existence of different kinds of teams complicates the application of training technology for systematic R&D. What works for the Army, with its collectives dispersed on and over the terrain, probably will not work for a team in a submarine or aircraft. Although the taxonomic characteristics of teams are implicitly recognized in the services, they deserve more systematic R&D attention. In fact, this is a key starting point for R&D.

In that CGTU training is a transitional area between individual training and the operational unit, it tends to blend into operations. Data for the determination of the scope of CGTU requirements are generally incomplete or unavailable. Except for aircrews and missile crews, no cost or training load data was provided to the Task Force. Thus, this section can only be considered a partial examination of CGTU training.

Army CGTU Training

Army CGTU training is predominantly a unit training function with no formal institutional training requirements. The great majority of personnel who complete MOS training at Army schools and training centers are assigned to TOE units as replacements. They receive CGTU training in the units in the form of individual on-the-job training, augmentation, cross-training, and collective training. Most training is performed on

operational equipment with the objectives of maximizing proficiency or readiness.

Collective and individual training conducted in the units is supported by TRADOC through the provision of training literature especially designed for units and by management of training-aids support services for CONUS installations.

In the Army, Advanced Flight Training is considered CGTU. Graduates of Undergraduate Pilot Training receive supplementary training in the specific aircraft they will fly on operational missions. This supplementary training is provided by the operational unit. The new pilot is integrated into the operational unit where he undergoes transitional training as a part of normal unit training.

Navy CGTU Training

As in all Services, CGTU training in the Navy consists of units that provide training to organized crews and units for the performance of a specific mission. The Navy discussed CGTU in these five categories as being typical: Pre-team Indoctrination Training; Subsystem Team Training; System Sub-team Training; System Level Operational Training; and Multi-unit System Operational Training.

Pre-team Indoctrination Training is conducted in a team context with emphasis on increasing the skill levels of the individuals who will later be assigned to operational teams. Examples of courses in this category are Electronic Support Measures, Submarine Damage Control, SSN Predeployment Team Training, and Emergency Ship Control.

In the second category, Subsystem Team Training, teams vary in composition under different conditions of shipboard readiness. The teams are divided into three departments: Combat System Teams (e.g., Search Radar Detection and Tracking); Unit Operations Teams (e.g. Navigation); and, Engineering Systems (e.g., Firefighting/Damage Control). The training methodology includes shipboard training, refresher training, classroom simulators, and pierside simulators/stimulators.

System Sub-team Training involves the training of two or more subsystem teams and generally an entire ship. Training methodology includes shipboard training, refresher training, classroom simulators and pierside simulators/stimulators. Some of the areas of training are anti-air warfare, anti-submarine warfare and underway replenishment.

System Level Operational Training is accomplished be at-sea-training because existing pierside simulators/stimulators do not have the capability of exercising an entire crew or a ship in all facets of an operation. This type of training is best described as a battle problem which is conducted by underway training units and fleet training groups.

Multi-unit System Operational Training is in-port exercises utilizing

shore-based trainers for the purpose of training crews prior to getting underway for the exercise operations area. Major in-port exercises such as CINTEX, FLEETEX, Workups, etc., utilize the Tactical Advanced Combat Direction and Electronic Warfare (TACDEW) Trainer.

Advanced Flight Training in the Navy is provided by training squadrons known as Replacement Air Groups (RAG): New crew members are trained in the particular aircraft they will operate prior to joining their operational squadron. Load and cost data of the RAG's are listed below. (Table 8-3)

TABLE 8-3

NAVY ADVANCED FLIGHT TRAINING, FY 1975

Aircraft	Location	Loads Officer Pilots	NFO RIO	Enlisted	Cost*
F-4	Miramar, Oceana	144	103	1229	$10,437,760
F-14	Miramar	81	80	571	2,476,041
A-7	Lemoore, Cecil	233	0	1967	8,745,753
A-6	Whidbey, Oceana	113	98	2084	8,323,513
EA-6	Whidbey	37	92	231	871,393
RA-5	Key West	31	22	717	1,720,891
E-2	North Island, Norfolk	58	50	599	1,688,184
P-3	Moffett Fld, PaxRiv	342	218	2147	5,010,941
S-2	Cecil Field North Island thru FY 1974	50	15	302	343,005
S-3	North Island	0	0	105	371,729
SH-2	Imperial Beach, Norfolk	53	0	209	2,616,518
SH-3	Imperial Beach, Jacksonville	117	0	516	1,078,771
Totals		1259	678	10677	$43,684,499

*Does not include student pay and allowances or military pay for instructors.

Source: Navy response to Task Force questions.

Air Force CGTU Training

In the Air Force, there are only four formal CGTU courses, all for the training of strategic missile crews. Students are provided training in the responsibilities and necessary technical procedures of the appropriate weapon system, but their proficiency upon graduation is less than required for combat-readiness. Thus, additional upgrade training is required at unit/base level prior to performance of actual crew duty. The four courses are:

1. Titan II Missile Combat Crew Operations Readiness Training Course (WS-LGM25C)
2. Minuteman Modernized Missile Combat Crew Operational Readiness Training Course (WS-133A-M)
3. Minuteman II Missile Combat Crew Operational Readiness Training Course (WS-133B)
4. Minuteman Modernized-Command Data Buffer Missile Combat Crew Operational Readiness Training Course (WS-133A-M/CDB)

Training loads (Air Force response to Task Force questions) for the four weapon systems are:

Weapon System		FY 1975	FY 1976	FY 1977
WS-LGM25C	Officers	172	212	146
	Enlisted*	170	200	180
WS-133A-M		326	270	262
WS-133B		150	92	18
WS-133A-M/CDB		172	202	202

*Note: Only the WS-LGM25C system has enlisted crew members.

The average FY 1975 costs per graduate of these schools are:

Weapon System	Cost (per graduate)
WS-LGM25C	$7,300
WS-133A-M	10,700
WS-133B	11,800
WS-133A-M/CDB	16,200

There are approximately 125 flying training programs in the Air Force which are considered Advanced Flight Training. Course length varies from 9 to 28 weeks with 13 to 141 required flight hours. The purpose of each course is to qualify a crew on a particular aircraft. Table 8-4 contains information on the major Advanced Flight Training programs.

TABLE 8-4

AIRCREW TRAINING COURSES IN THE AIR FORCE

Aircraft	Location	Title	Crew(s)	Flow	Duration	Flt Hrs	Description
F-4	Luke George Homestead McDill	Opn'l Trng Crse	Pilot Nav	301 291	28 wks	100	Trains crews to operate the F-4 as a weapon system. Graduates are mission capable in the F-4.
RF-4	Shaw	Opn'l Trng Crse	Pilot Nav	96	15 wks	93	Trains crews to operate the RF-4C as a weapon system. Graduates are mission ready in the RF-4C.
A-7	Davis-Monthan	Opn'l Trng Crse	Pilot	66	17 wks	85	Trains the pilot to operate the A-7 as a weapon system. Graduates are mission ready.
F-111	Nellis	Opn'l Trng Course	Pilot Navy	47 47	12 wks	31	Trains selected aircrews in the operation and use of the F-111 weapon system. Graduates are not combat ready or mission capable.
B-52D B-52G/H	Carswell Castle	Combt Crew Trng Crse	Pilot Co-Pilot Rdr Nav Nav EWO Gunner	80 336 89 255 158 110	17 wks	125 141	Trains in procedures and techniques of operating B-52 aircraft. Student will be mission qual. after additional training at unit.
KC-135	Castle	Cmbt Crew Trng Crse	Pilot Co-Pilot Nav Boom Op	79 581 273 133	13 wks	85	Trains procedures and techniques of operating KC-135. Students graduate initially qualified and will be mission qualified after additional training at unit.

TABLE 8-4 (Cont'd).

Aircraft	Location	Title	Crew(s)	Flow	Duration	Flt Hrs	Description
FB-111	Plattsburgh	Cmbt Crew Trng Crse	Pilot Rdr Nav	34 35	26 wks	66	Trains aircrew in prodecures and techniques of operating the FB-111.
C-130	Little Rock	Adv Fly Tac Trng Crse	Pilot Nav Flt Eng Ldmstr	368 184 184 184	9 wks	42	Qualifies the crew to perform the tactical mission in the C-130.
C-141	Altus	Adv Fly School	Pilot Nav	492 291	9 wks	13	Qualifies the crew in the C-141 aircraft.
C-5	Altus	Adv Fly School	Pilot Nav	224 112	9 wks	15	Qualifies the crew in the C-5 aircraft.

Source: Air Force Response to Task Force Questions.

8.3 DESCRIPTION OF CGTU TRAINING PROGRAMS AND COSTS

The only CGTU program described by the Army is one in which they have endeavored since 1974 to develop a program that provides trained teams to overseas commands in lieu of or in addition to individual replacements. The purpose of this program is to improve combat readiness and team proficiency by training, deploying and maintaining teams as units. The initial program has been restricted to tank crews deploying to Europe. At present, the program to furnish trained MGOA2 tank crews to Europe is in the initial stages of implementation.

In the Air Force, all formal strategic missile crew training is conducted by the 4315th Combat Crew Training Squadron at Vandenberg AFB, CA. The training programs are nearly parallel with differences stemming from differences between the weapon systems. Generally, for all systems, instruction is provided on weapon system operation and SAC emergency war-order procedures. Course requirements for each system are:

Weapon System		Academic (Hrs)	Simulator (Hrs)
WS-LGM25C	Officers	126.5	65
	Enlisted*	66.5	65
WS-133A-M		188	90
WS-133-B		222	102
WS-133-A-M/CDB		242	120

*Note: Only the WS-LGM25C system has enlisted crew members.
Source: Air Force response to Task Force questions.

8.4 SCOPE OF TRAINING TECHNOLOGY R&D SUPPORT

General Comments on R&D Programs

In view of the amount of CGTU training that goes on in the three services, either formally recognized as training, as in RAG or CGTU squadrons, or combined with operations, the funds committed to R&D support are relatively small. Funding tends to be fragmented among a lot of little projects, which often do not have the critical mass to be very effective. (See below.)

The kinds of R&D projects described by the services vary from "packages" designed to support some part of a weapon system to concerns, much less evident, with pervasive problems such as team performance measurement. By and large, most of the R&D is strongly mission-oriented and is one aspect of a larger, usually hardware, program (Navy S-3A, P3C, F-14, and SH-2), or a tactical data system (Marine TESE and TWAES)

or a simulator (Army CATTS).* Significant exceptions are noted in the program of the Army Research Institute for the Behavioral and Social Sciences which currently is being influenced by TRADOC interest in and emphasis on collective training in both equipment-oriented and maneuver-oriented skills, and in TRADOC programs, which have used OMA funds (see below). There is recognition in these programs of the CGTU performance measurement problem, which is a fundamental stumbling block to progress in improving CGTU training. Commensurate funding of research on this pervasive problem is less visible.

Examples of R&D projects in the FY 1972-FY 1975 time frame are cited below, as given to the task force by responding elements of the services.

USAMC, U.S. Army:

"The data provided in response to the above questions pertain to Project 1X76471D572, Nonsystem Training Devices. Funding for this project is shown below:

FY 1973 - $1,350,000

FY 1974 - $1,750,000

FY 1975 - $2,400,000

Tasks: Armed Aircraft Qualification Range System
Laser Tank Gunnery Trainer*
Hit Kill Indicator**
Combined Arms Tactical Training Simulator
Multiple Integrated Laser Engagement System

* Completed
** Terminated

Under Project 1X76471D572, Nonsystems Training Device Development, the following R&D tasks are applicable to CGTU Specialized Skill Training. These items are based upon DA approved requirements and support unit training in the field.

1. The development of the Laser Engagement System began in FY 1973. It consists of the following training device requirements:

    a. M16A1 Target Engagement Simulator

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* Appendix 8-1 provides brief descriptions of TESE, TWAES, CATTS, and training packages for S-3A, P-3C, F-14 and SH-2.

b. Vehicle Engagement Simulator

c. Machine Gun Laser

d. Field Target Screen

e. Moving Target Screen

All items with the exception of the Field Target Screen will undergo initial field testing within the next several months. These devices will provide for the simulated engagements of small tactical units. The system uses low power lasers in place of live ammunition to provide a realistic training environment.

Total funding for this effort is $1.5 million.

2. Development of the Combined Arms Tactical Training Simulator (CATTS), was initiated in FY 1973. The purpose of this trainer is to provide Battalion Commanders and their staffs with simulated combat situations operating from a ground command post. The simulator utilizes a Xerox Sigma 9 computer to meet the following training objectives:

   a. Identify the relationships that exist among various elements and with the enemy.

   b. Identify alternative courses of action, appropriate formation, maneuvers and fire support application.

   c. Communicate decisions to subordinates using tactical orders so that decisions can be effectively interpreted.

   d. Manipulate and monitor the variety of tactical radio networks available at the battalion level.

   The CATTS system currently being developed will be installed at the Infantry School, Ft. Benning, GA, during the 1st quarter calendar year 1975 with operational testing to follow for approximately six months.

   Total funding through completion of testing is $2.5 million.

ARI: U.S. Army

"The answer to this question is provided in a format similar to that used in the FY 1975 Technical Coordination Paper. Research problem areas are described broadly, conforming to TCP research categories for education and training. It may be noted that appreciable 6.2 funding

has been devoted to the evaluation of individual and unit performance in the CGTU context. Modern instructional system design principles are based on the clear statement of performance requirements and the standards to be achieved. Performance requirements and standards provide the (measurement) goal against which CGTU training is being undertaken by the Army, with emphasis on the combat arms. The primary emphasis during FY 1973-FY 1975 has been in the translation of principles of effective individual instruction to the CGTU context. As will be noted in more detail below, significant breakthroughs have been achieved."

TABLE 8-5

ARMY RESEARCH INSTITUTE R&D PROGRAM

RELATING TO CGTU TRAINING

Program Element:	6.27.17 A			6.37.31 A					
Project	A 722			A 757			A 762		
Fiscal Year	1973	1974	1975	1973	1974	1975	1973	1974	1975
Problem Area									
How to Evaluate Educ/Trng Prgms								113	
How to Design Educ/Trng Methods & Media									87
How to Evaluate Trainees	260	389	174				270		
New Generation Educ/Trng Systems					131	343			441
Guidepost Applications	440			50	375		310	309	

TABLE 8-6

TOTAL RDTE EXPENDITURES BY ARI FOR CGTU R&D

FY	ARI	COLLECTIVE (CGTU)
1973	14.3 Million	Less than 1.5 Million
1974	14.3 Million	Less than 2.0 Million
1975	14.3 Million	Less than 2.5 Million

(Source: TRADOC Memo, 30 Jan., 1975)

TRADOC: U.S. Army

The full R&D picture is not obtained by examining the formal RDT&E program for collective training (see table above). Over the past three years CONARC and then TRADOC funded a sizeable collective training R&D effort with their own OMA funds. The bulk of these OMA funds were derived from the Combat Arms Training Board (CATB) budget or from support provided by units in the field. For example, the 1971 Board for Dynamic Training final report indicated that the single most pressing problem in the Army was individual training. Over the next two and a half years a newly created organization, the Combat Arms Training Board, addressed this problem by conducting a major research effort to determine the most appropriate solution. This research cost CONARC/TRADOC some 14.225 million dollars in OMA and OPA funds in FY 1972, FY 1973 and FY 1974. Listed in Table 8-7 is a synopsis of OMA R&D projects conducted by the Combat Arms Training Board from 1 January 1972 to date. Although figures are unavailable which precisely reflect expenditure for each program, a reasonable estimate is that about 2/3 of USACATB's 1.5 million OMA budget and 35-officer strength was expended in support of collective training R&D for FY 1973, FY 1974 and FY 1975.

TABLE 8-7

SYNOPSIS OF OMA R&D PROJECTS

1. TWAES. The Tactical Warfare Analysis and Evaluation System is a computer assisted system to control tactical field training exercises. The system offers potential improvements in maneuver control and the simulation of indirect fire. In September 1974, the system was evaluated in the 9th Infantry Division for possible adoption by the U.S. Army. The evaluation report was forwarded to TRADOC in January 1975.

2. 101st Division Squadron Training Program (STEP). A CGTU training program for squads and platoons which trained leaders to conduct training for their units. The program was integrated in the 101st Division training during 1973, but due to personnel turnover and lack of institutionalization is no longer used.

3. CPX Control Game. A tactical level simulation of battalion-sized operations designed to provide realistic input for CPX's. Researched and developed by USACATB, the game is being validated prior to field implementation.

4. Combat 75. A tactical simulation of mechanized platoon-sized operations against an equivalent sized force. The game was developed by USACATB to teach U.S. and Soviet weapons and organizational capabilities and limitations. It is about to undergo field validation prior to implementation.

5. Tanker Game. A game designed to teach armor-related subjects to tank crews. The game was developed using instructional technology methods, field

validated and turned over to Training Aids Management Agency for field implementation.

6. Battalion Staff Game. A game similar to Tanker Game designed to teach the tasks expected of a staff officer in a combat situation. The game has been field validated and awaits funding for implementation to field units.

7. Anti-armor Training Program. Technical training assistance was provided to the 82nd Division during the development of a multi-level CGTU anti-armor training program. The program incorporated the various facets of anti-armor training for the first time and trained using the precepts of FM 21-6. The program was developed in December 1973 and continues to be used in the 82nd Division.

8. Combat Vehicle Simulator (CVS). The CVS was designed to optimize leader training in mounted tactical command and control procedures when constraints such as limited maneuver space, maneuver damage considerations, limited POL, and nonavailability of combat vehicles exist. An extensive field validation of the CVS was begun in 1972 and continues to date.

9. Vulcan Training System (VTS). Developed by the USACATB using off-the-shelf items (7.62mm mini-gun, TVT, model airplane, and vulcan gunner monitor). The training system was field evaluated at Fort Hood, Texas 21 October through 15 November 1974. The VTS provides the vulcan unit commander the means to evaluate and train vulcan gunners. VTS is awaiting TRADOC final approval prior to field implementation.

10. Small Arms for Air Defense (SAFAD). A training program developed by 82nd Abn Division and funded by USACATB. The program was evaluated by the XVIII Abn Corps, Fort Bragg, NC., June through October 1974. The SAFAD program is an economical method of training division forces in the use of small weapons (5.56, 7.62, 50 cal.) against aircraft. It is being considered for Army-wide implementation.

11. Redeye TVT Brackets. Developed and funded by the USACATB. The brackets were designed and built by the TASO at Fort Jackson, SC. The items were distributed to all combat and combat support units in January - March 1974. The TVT brackets allow the Redeye section leader to evaluate and train his gunners in tracking and firing procedures.

12. Mortar Training Program. During 1974, technical training assistance was provided by USACATB to the 25th Division and 197th Brigade in an effort to develop a viable performance-oriented training program. A pilot program was developed but higher priorities precluded its testing or implementation. The Army needs further research in this area.

13. Tank Gunnery Sub-caliber Devices. Developed in response to a need since few tank ranges are available for main gun firing. A number of devices were developed and USACATB evaluated their effectiveness during

1973-74. The program is eventually expected to evolve into issuance to the field of subcaliber devices.

14. Mini Tank Range. A miniature tank range utilizing an exterior mounted subcaliber device on a scaled sand table simulating main gun engagement. The range allows tank gunnery in a reduced area and enhances CGTU training. Ranges are in existence or under construction in the 1st Cav. Division, 2d Armored Division, 4th Mech. Division and the 3d Armored Cav. Regt.

15. Plastic Landmines. Plastic mines which are identical to actual mines to be used in CGTU training. The kits (enough for a 100m minefield of 1-2-2 density) were field evaluated in 1974 and issued to Training Aids Supply Offices servicing CONUS.

16. Systems Engineering of a Mech. Inf. Battalion. A major research effort designed to produce tasks, conditions, and standards for all the CGTU of a mech. infantry battalion. Completed in June 1974, the results provided input to the development of the mech. infantry ARTEP.

17. System Engineering of a Field Artillery Battalion. A major research effort designed to produce tasks, conditions, and standards for all the CGTU of a field artillery battalion. Completed in July 1974, the results provided input to the development of the Field Artillery ARTEP.

18. ARTEP Validation. The field validation of the Armor, Mech and field Artillery ARTEP's was conducted during 1974 and 1975 in the 9th Division, the 4th Division and the 1st Cav. Division. Results of the validations will be incorporated in the final ARTEP's which will replace the ATP/ATT.

NPRDC: U.S. Navy

1. Team/Crew Training for New Aircraft Systems

NPRDC has been given management responsibility for the development and delivery of both individual and team training packages for four new Navy aircraft systems. As regards CGTU, each system requires the development of scorable training scenarios to be used with each system's operational system trainer, or equivalent. The four systems with their associated funding in $1,000 are:

S-3A - A Carrier-Based ASW System

FY	1972	1973	1974	1975
Category	6.6	6.6	6.6	Procurement
In-House	69	120	100	80

P-3C - A Patrol Aircraft with Heavy ASW Commitment

FY	1975	1976	1977
Category	6.5	Procurement	
In-House	45	69	40
Contract	43	313	175

S-H2 - An ASW Helicopter

FY	1975	1976
Category	6.2	6.2
In-House	100	100

F-14 - A Two-Man Fighter

FY	1975
Category	6.2
In-House	15

2. Use of the Tactical Exercise Simulator and Evaluator (TESE) to Train Marine Corps Officers in Combat Decision-Making.

   Project seeks to define procedures for wargaming with TESE(operational in 1976.) Goal is to get both computer-based individual and team measures during amphibious warfare exercises, and also increase the number of trainees who can be processed.

FY	1973	1974
Category	6.2	6.2
In-House	25	50

3. Evaluating Marine Corps Tactical Field Exercise Performance.

   Seeks unit performance measures, minimally contaminated with momentary situational and environmental factors. The data are to be made compatible with the computer-based Tactical Warfare Analysis and Evaluation System (TWAES).

FY	1974	1975	1976
Category	6.2	6.2	6.2
In-House	50	60	100

4. Controlled Combat Simulation for Marine Rifle Squads.

Seeks to develop a training system that will allow controlled practice and evaluation in a field environment. Both individual and team skills are to be measured.

FY	1974	1975	1976	1977
Category	6.2	6.2	6.2	6.2
In-House	50	60	85	50

5. Mediated Instructional Aids for the Mobile Training Teams of the Landing Force Training Command.

Seeks to lower the high instructor load currently required by the Mobile Training Teams. Instructional media must be low-cost, rugged, and air transportable. Point of focus is the Landing Force Staff Planning Group.

FY	1974	1975	
Category	6.2	6.2	(Navy Science Assistance Program)
In-House	51	47	

U.S. Air Force:

Functional Integrated Systems Trainer (FIST). The FIST is to provide a better means for training four members of the fire control team on the AC-130E Gunship. The second objective is to refine and promote the use of the technology for developing low-cost, interlinked, functional, part task trainer.

General Comments on New Starts and Completed R&D Programs

Most, if not all of the R&D programs that were described are new starts as of FY 1972. There have been earlier research programs in this area (e.g., research in the Navy on TACDEW) off and on for twenty years, usually at a similarly low level of effort. A notable exception a decade ago was the Systems Training Program for the Air Force SAGE system, which was funded at the multi-million-dollar level for a number of years, and was remarkable for its scope and for the size of the higher-order CGTU's exercised, e.g., the Air Defense Systems of the entire continent. There is no indication that lessons learned or expertise developed during this era have been preserved in any useful form.

General Comments on Incentives for Change in R&D Programs

Three factors were identified in service responses to this question as creating pressures for or opportunities for change in R&D programs; new technology (lasers and computers), inflation and energy crises, and command pressures. It should be remembered that these factors are, essentially outside the R&D and the training communities.

Lasers and digital computers are tools that could be used in a variety of ways to improve training. The Army is using lasers for simulating several components of the fire control training problem to reduce costs and to improve markmanship. Digital computers offer their well-known data-processing power for data-recording and for data-analyzing in the complex and ill-defined processes that constitute CGTU training, and hold forth the promise of eventual control over these processes, although this power is just beginning to be used. These are essentially fortuitous incentives for change in Training Technology R&D and represent opportunities that either can be exploited or ignored. There are some signs that their broad implications for cost reduction are being recognized. The inflationary pressures in the economy certainly are generating pressures on the training institutions in the services to substitute less expensive means, e.g., subcaliber ammunition for cannon shells, to do training. The energy crisis focuses pressures more on vehicles that consume petroleum products, such as tanks and aircraft. Here, the simulator has been resurrected as a substitute, and with all the uncertainties and doubts about transfer of training in the more complex performance areas such as air-to-air combat, where the aviator, it is claimed, becomes an integral part of the aircraft.

Command interest as an incentive for change in R&D programs was conspicuously not evident in Navy and in Air Force responses. This may have been an accident of the fact that most CGTU training is embedded in operations and is the responsibility of unit commanders. These operating commands have their own institutional programs for proficiency maintenance and typically have little interaction with the R&D community. It evidently is not particularly fruitful, judging from service responses to look for incentives for change in training R&D in those commands. Indeed, a representative of the Navy Training and Education Command (CNET) indicated that unit commanders do not think in terms of R&D requirements.

An outstanding exception to this disquieting picture is the strong initiative currently being taken by the Training and Doctrine Command (TRADOC) of the Army. It has established a Combat Arms Training Board (CATB) which acts as an intermediary between the R&D agencies and the operating commands. CATB takes the initiative in demonstrating to the operating commands that their sterotyped conceptions of collective training (platform-podium-pointer-poop) are stifling improvements in the proficiency of their units. CATB is demonstrating the kind of creative thinking that takes advantage of existing resources and of cost-avoidance innovations.

In addition, TRADOC is in a position to institutionalize change once made, because it controls the formulation of doctrine and, through the Army Training and Evaluation Program (ARTEP), may in the future control assessment of unit effectiveness.*

The current TRADOC/CATB experiment in effecting institutional change is a bright spot in an otherwise dismal picture of institutional inertia and resistance to innovation. However, the current TRADOC initiative

*ARTEP is described in Appendix 8-2

clearly is a consequence of the interest and dedication of a few specific individuals at high enough levels in the command structure to be heard when they speak. In the long term, what will happen when these individuals move on to other commands? The history of R&D implementation in this area leads to the conclusion that institutionalization of change is the exception, not the rule. The incentive for change in R&D programs represented by pressures from command evidently tends to last only until there is a change of command.

General Comments on R&D Benefits, Major Findings, and Innovations

It may be significant, in view of the above discussions, that the majority of the benefits of R&D were listed by agencies of the Army. They fall generally into four categories: (1) simulators, many relatively low cost, to substitute for real vehicles or for live ammo firing; (2) devices and methods to improve the effectiveness of the way existing resources are used in training (REALTRAIN is an outstanding example, see TC 71-5, January 1975); (3) methods for measuring unit performance, the Unit Performance Assessment Model (UPAM), or for controlling training processes during Unit Training (UTRAIN), or for simulating team training requirements via games and scenarios (Corporate Battalion Simulation Game); and (4) studies to acquire data on the effectiveness of one method in comparison to another (the contribution of live firing to weapons proficiency).*

It is apparent in some cases, where lasers or subcaliber devices were substituted for artillery, that cost avoidance must be great. If effectiveness remains the same or improves, this would be worthy of documentation in cost-avoidance terms.

General Comments on Difficult Areas of CGTU Training

The Army and Navy, responding to this question, described these difficulties very well. This kind of R&D must be piggy-backed on operations in the field, large numbers of R&D personnel are required, the opportunities for data collection during the exercise are marginal, inferential statistics and psychometrics were not designed for this order of complexity, there are limited opportunities for repeated trials, the ultimate test of team training is combat, which cannot be simulated. Indeed, these difficulties have resulted in certain postures on the part of the R&D community: CGTU training may be avoided altogether, or the problem may be fragmented into small pieces that are studied individually, in projects tailored to typically small resources. There is no doubt that these factors constitute a critical problem for R&D on training in this area, or that R&D in this area must have strong support from both training and operational commands (users), if it is to be successful.

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* REALTRAIN, UPAM, and UTRAIN are described in Appendix 8-3.

8.5 ANALYSIS AND EVALUATION OF CURRENT EFFECTIVENESS OF TRAINING TECHNOLOGY R&D PROGRAMS AND MANAGEMENT

The determination of R&D requirements for CGTU training could result from analysis of training as a systematic process, or from the pressures of new hardware acquisition, or from those doing the training or from an inventory of new developments in other fields also promising for training technology, or from the personal biases of those who control R&D funds, or from particular capabilities existing in R&D agencies, or from combinations of these.

There are, of course, formal guidelines in the services for establishing training R&D requirements, which are described in regulations and instructions. These also presumably would apply to CGTU training R&D requirements. In the case of the Army there also are well-defined procedures for systematically collecting Human Resources Needs (HRN's) and prioritizing them in terms of an annual work program statement in meetings with the ARI, TRADOC, and field agencies, which result in a work program. (This process is different in the Army for hardware R&D requirements; the coordinating agency is the Project Manager for Training Devices.) Somewhat comparable procedures exist in the Navy and Air Force, although they appear to be considerably less structured in the Navy.

Since CGTU training R&D is receiving strong command attention in TRADOC, it therefore could be in a position of relatively higher priority when it comes to the allocation of resources to training R&D requirements, provided this thrust was also supported by FORSCOM. A significant proportion of these resources has come, in the past several years, from OMA funds, and represents TRADOC R&D, in distinction to ARI R&D. (A list of these projects was given above.)

Responses from the other services were too general on this point of priorization to allow comment, other than that expressed needs of users seem to drive resource allocation to applied R&D at some levels. It appears that, in the case of the Navy, these needs are expressed primarily to the Naval Personnel Research and Development Center (NPRDC) and that this initiates a dialogue in which requirements are more clearly delineated and balanced against resources available to the concerned agencies. It is likely that this kind of dialogue does actually go on between R&D elements and users elsewhere,and that through such dialogues, effective resource allocation can occur, provided there are resources to allocate from block funding from higher places. In this regard, TRADOC estimated that the amount of CGTU training R&D funds available should be several times that which is being expended at present. In support of this contention, TRADOC listed 21 areas for which critical CGTU training requirements exist but no work is being done. (We assume HRN's have been submitted.)

<u>Critical Research Needs</u>

1. Tank Gunnery Training Program

   - Improved Scoring Procedures for Tank Gunnery (ARI)

- Tank Gunnery Proficiency Maintenance Program (ARI)
- To define Tank Crew Performance Standards and how to train

2. Rifle Squad Tactical Training Program

3. Combat Unit Evaluation

   - For units with and without MILES or REALTRAIN

4. Refine REALTRAIN Eng Sim Techniques

   - Expand to LAW, DRAGON

5. Validation of UPAM

6. Weapon Systems Effectiveness Baseline Data

   - Tank Gunnery
   - Small Arms (M16, M60, M203, Cal .50)
   - Anti-Tank Systems
   - Small Arms for Air Defense

7. CPX Control Game

8. Rifle Company Anti-Armor Training Program

9. M16 Rifle Marksmanship Training Program

10. Laser Engagement Simulation for Small Unit Tac Tng

    - Mix of MILES, REALTRAIN and Alternate Tng Methods

11. Mortar Platoon Training Program

12. Development of Improved Battalion CPX

13. Improved Control System for FTX

    - Follow-up to TWAES
    - Indirect Fire Simulation

14. Combat Unit Performance Requirements and Standards

    - AR 220-1 (ARTEP)

15. Simulation Effects of Model Plans for Air Defense Tng

16. Rifle Company Air Defense Training Program

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17. Tng Lit use in Unit Training

18. Tng Lit Evaluation

19. Impact of Tng Lit on Wpns System Eft

20. Expansion of REALTRAIN to Platoon and Company

21. Reserve Component Model Training Programs

Discussion in terms of how the system of establishing R&D requirements could be improved contained a number of suggestions by the services. Most of these boil down to procedures for better integration of requirements into overall programs concerned with major areas or problems, better communication between the R&D community and the training community, the development of methods for cost-avoidance predictions for proposed research requirements, a continuous rather than a once-a-year system for submission of research requirements to permit more flexibility in response to these requirements, and requirements generation based on quantitative analyses of present training effectiveness of procedures and systems.

These suggestions, if implemented, presumably would lead to better R&D for the R&D dollar, through more effective allocation of resources on a more timely basis and concentration on programmatic, integrated projects more likely to have high payoff in the context of systems-effectiveness baseline data.

There evidently are no formal or informal procedures for evaluating the efficacy and efficiency of the CGTU training R&D requirements generating process, thus the discussions of how it might be improved remain speculative.

Interservice coordination of resource allocation for CGTU training R&D requirements was said to occur through informal relationships among the different agencies involved, and formally through the Instructional Exchange Subgroup of the Interservice Training Review Board. It is not clear, however, how effective this board is, or the extent to which the R&D community is represented in its deliberations.

Several methods for maintaining contact with the operationsl environment were described by the R&D agencies.* CGTU training R&D is peculiarly demanding in this respect, since in many cases it can only be done in the operational environments or in simulators, in distinction to laboratories. R&D personnel who would do this research are forced to work with operational personnel and to become familiar with these environments.

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*Data presented to the Task Force on the relationships of the R&D and user communities are given in Appendix 8-4.

8.6 APPLICATION AND IMPLEMENTATION OF CGTU TRAINING TECHNOLOGY R&D

As pointed out earlier, TRADOC is possibly in a unique position to insure implementation and institutionalization of R&D through control over training and doctrine publications and, in the future, proficiency standards for units. The most effective procedures for implementation of R&D otherwise were described in a review of HumRRO's history. In addition to maintaining field offices and a research organization closely tied to all levels of the Army, research projects that were successfully implemented tended to fit into the climate of the times with respect to user requirements, and did not require too radical a change in the user's environment.

The R&D community generally does seem to be recognizing that it must be concerned with implementation and is taking this responsibility more seriously, having found, too, that successful implementation is professionally satisfying. There also was exhibited a sensitivity to the need for a continual dialogue with the consumer throughout the life of the project. This marks a definite change in emphasis with respect to the way products of R&D often were handled, say, ten years ago, and this should be recognized in the funding categories. That is, there should be more flexibility in allocating 6.1-6.4 funds to allow for implementation by the original researcher, rather than relying on handover of promising 6.1 research to 6.2, then to 6.3, etc. This is more a system for assuring that good research falls through the cracks in the floor, rather than being handed over to someone else who is going to implement it. Institutional signs of this sensitivity are represented in the Training Analysis and Evaluation Group (TAEG) in the Navy, and in the Combat Arms Training Board (CATB) previously mentioned. Both of these have interfacing roles between the R&D and the user communities. No similar group was evident in the Air Force.

Several examples of successful implementation cited included REALTRAIN, UTRAIN, the guidebook for the development of Army training literature (Army); NPRDC work with the S-3A and P-3C aircraft, with TACDEW and the Marine Corps TWAES (Navy); application of the ISD to the A-4 program and the SAT/ISD approach to the B-1 bomber development (USAF). Most of these projects really are still in progress.

A few examples of unsuccessful implementation of team training research cited were attributed to untimeliness, inappropriate resources, or shifts in the operational situation between conception and delivery. A more frequently cited deficiency was the failure altogether to implement promising research results. The following are examples cited by TRADOC:

> "Over the past two decades excellent research occurred in the area of collective training. The HumRRO evaluations of squad training in 1955 and again in 1965 were quite good. Each articulated a program for training a rifle squad using training methodology beyond that seen anywhere else in the Army. However, these programs and other successful efforts, such as the Small Independent Action

Force, had no impact on the Army in the field. It is only recently, following the report of the Board for Dynamic Training, and a slight increase in emphasis in the Army Research Institute, that the results of research have had any impact on unit training."

8.7 CONSIDERATION (ANALYSIS AND EVALUATION) OF ALTERNATIVE MANAGEMENT APPROACHES AND STRUCTURES (COST-EFFECTIVENESS CRITERIA)

It is evident that CGTU Training Technology R&D has several roles to fulfill in relation to the commands, whether operating or training, and therefore that the management, content, and application of this R&D must be sensitive to these multiple roles. The R&D projects described by the different service laboratories can be placed into the following categories.

Personnel Subsystem Support of New Weapon Systems

The S-3A project, (NPRDC) is an example. The requirements for R&D are, essentially, to develop a training package for the user. This involves using some relatively standard procedures to do the task analyses, to organize subject matter, and to develop measuring instruments, plus assembling appropriate media and staff for implementation. To the extent that the media are new and untried or the weapon system includes new or troublesome man-machine interfaces, this kind of support effort may involve some additional R&D. Otherwise, it is highly useful sythesis of available technology. Because it necessarily requires close cooperation and interaction between R&D and user groups, is done at the user's site, in his environment, involves his personnel, and usually continues until the training package has been installed and evaluated. This kind of R&D can be very effective (if successful) in promoting dialogues between research and user groups which lead to other cooperative efforts. Under these circumstances, R&D requirements generation starts with the user, but evolves out of the initial dialogues between R&D personnel who have specialized knowledge about training technology to contribute, and user, who contributes the weapon system and, usually, the funds.

Innovative Applications of New or Old Technology

The various REALTRAIN projects originated by a contractor, and now pursued by ARI are examples. This kind of R&D adds some new element to a training environment that immediately results in dramatic improvements in training processes and outcomes. (In the case of REALTRAIN, the telescopes and identifying numbers on targets enabled training to become a competitive interaction between the units engaged without use of a canned scenario. Thus, training became a game that could be won or lost by either side.) This kind of R&D involves, first of all, creative imagination in modifying familiar elements on the user's home grounds for initiating a tryout, and the resources for carrying through to an evaluation.

This involves quite different requirements generation, management,

and implementation techniques. First of all, there must be the bright idea and the context to stimulate it. Bright ideas spring from bright minds, and cannot be ordered up on demand by OPNAV Instructions, Army or Air Force Regulations, or similar bureaucratic fiats. The bright idea might never occur if these were the only stimuli. Second, the user community may be indifferent or hostile to the bright idea. Its support and funds are not assured from the beginning. There is a risk that the bright idea will die a quick death, or else that it will take years until conditions in the user community are auspicious for a tryout. This kind of R&D would seem to be dependent upon the R&D community for requirements generations, initiation, management, funding, and implementation. It follows that the R&D community must have the unfettered resources, and the initiative, and the bright minds to do this kind of research. The present R&D block-funding thrust would seem to be a reflection of this view. Since creative imagination is needed in all categories of CGTU training research, block-funding should be supported by taxonomic and systems analyses of CGTUS and CGTU training, leading to programmatic research plans which identify the problems and which match the resources to the problems, instead of, as is the present situation, matching the problems to the resources.

Effective Utilization of Existing Technology

The embedded training project (ARI) is an example. The Navy's Mobile Integrated System Trainer, Evaluator, and Recorder (MISTER) is another. MISTER is a trailer-sized package of data-processing and other technologies that can be used as a dockside add-on to control CGTU training with the ships' existing systems.

In this type of R&D, a resource in the training environment is put to more effective use or technologies are added to this environment. The digital computers in some time-sharing and data-processing systems may be used for student monitoring, data-recording and analysis, and adaptive instructional scheduling. Digital computers are used in weapon systems and tactical simulators to help reproduce elements in operating environments. This does not automatically assure that the simulators are used most effectively for training, even though the data-processing elements for performing the above instructional functions may be, or could easily be made, available. The requirements in this case include development of a support package for insuring effective utilization of the simulator and for educating the user to use it. In this case, requirements do not necessarily come from the user. Again, there is likely to be indifference or hostility in this community for the concept. And, the history of this R&D indicates that improvements are temporary. Once the R&D group implements the package and leaves, simulator utilization tends to drift back toward inefficiency. The management of this kind of R&D, from requirements generation to evaluation is likely to fall on the R&D, not the user community.

A serious problem in this regard is the fact that, since procurement

of hardware for simulators often is divorced from the part of the R&D community concerned with instructional processes, implementation of existing instructional technology in these simulators is rare.

Research on CGTU Training Parameters and Variables

The plans of the NPRDC for initiating a unit training testbed is an example. This kind of R&D requires a critical mass of resources and staff, and the necessary cooperative participation of the user community for doing systematic research on the pervasive problems of CGTU training. It must be done on a large enough scale, and for a long enough time if it is to converge, through successive iterations, on general principles and methods applicable in generic categories of CGTU training. It should be pointed out that the existing simulators for fleet training (Navy) and for air crew training (USAF) would be good candidates for starting this cooperative, symbiotic relationship between user and R&D communities. In this kind of R&D, which really does not exist as yet for CGTU training, the R&D and the user community must establish a symbiotic relationship in which each contribute their unique resources and expertise toward reaching a common objective. Requirements would be generated from a systems analysis of training processes and from taxonomic analyses of CGTU's. Some of these general systems requirements are discussed below, as a way of illustrating their nature, with no thought of an exhaustive treatment of the subject.

Instructional System Analysis and Design. Procedures for designing instructional systems have been developed by R&D and are being applied in some of the services. The ISD and SAT prescriptions are examples intended to be broadly applicable. The design of the AIS is an example of an instructional systems analysis done for one specific application, for the USAF at Lowry AFB. So far, however, these system analyses tend to be applied to individual rather than CGTU training.

Two things can be said about these prescriptive guides. Like any other prescriptions, they can be seen as busywork laid on the training community, and they are just first approximations to analysis and control. The existence of SAT/ISD methods should not foreclose continued R&D on systems analysis of training, oriented toward defining systems with stronger control over inputs, processes, and outcomes for CGTU training.

CGTU Training Objectives. A great deal of R&D has been done on how to define training objectives for individualized training. Not so much has been done for team training objectives. The procedures to follow in doing this should be concerned inside the unit with the intra- and inter-team responsibilities of each crew member which involve interactions with other crew members and units. Although many of these are prescribed by tactical doctrine, these formal prescriptions tend to be quite general. Interpersonal interactions involve considerations of how much of each man's job other team members

should know, and communicative and coordinative skills at "meta-performance" levels. That is, at the performance-monitoring control and self-organizing levels, which maintain CGTU performance during exercises and which are responsible for the growth of team proficiency. Outside the CGTU, there is the critically important requirement to continually redefine the objectives of teams, at all levels, in terms of new weapons and likely next wars. (It can be assumed that this does go on, that it is an integral process in military institutions, and that the appropriate kinds and numbers of professionals are devoting their professional brains to identifying these requirements, But, history does not entirely support this assumption.)

Dynamics of Group Learning and Group Performance. When is a student learning team performance skills in distinction to individual skills? What characteristics of group situations in general facilitate or interfere with the individual team member's learning? What are the different team structures and what are the effects of each on learning by individual members? It may be team exercises present very different opportunities for learning and may have widely different effects on learning for different teams. TRADOC noted, for example, that some collective training procedures used in the Army really employed the collectives to train a few leaders, without correspondingly effecting the proficiency of other individuals in the unit.

The kinds of individual behaviors which in combination mean the difference between team performance and a group of individuals performing at the same time deserves additional R&D attention. It would be useful, in this regard, to investigate the approaches to the treatment of group dynamics in team training in the different services. An Army survey of training in the British Army (1973) revealed a quite different approach than is common in our services; one which the analyst evidently felt was superior in concept, and cost-effectiveness of results, although not entirely applicable in the U.S. Army structure.*

Instructional Methods, Materials, and Media. The standard paradigm for team training calls for giving a team some preliminary instruction, putting it into a real or simulated operational environment and letting it try to perform, then debriefing it. How can this paradigm be improved? The Army is testing some relatively simple, yet striking innovations developed by R&D. REALTRAIN is an example. The project to use laser technology to develop the Laser Engagement System is another. The application of SAF/ISD principles to the A-4 and A-7 training (USAF) is another. These techniques provide elements ordinarily missing in unmodified operational environments to create effective training environments. The point made by these examples is that good R&D directed to improving instructional methods, materials, and media could have high payoffs.

* The survey of training in the British Army (1973) is presented in Appendix 8-5.

Simulators. Some types of CGTU training are so costly that the operational situation cannot be the primary medium for continuing CGTU improvement or for maintenance or proficiency. The current energy crisis in the United States has definitively moved the "too costly" threshold higher, with resulting impact on more types of CGTU training, the obvious example being air crew training. Simulators have been common fixtures in individual training for many years. The technology for producing high fidelity of simulation is the basis of a big business today. However, it appears that the most effective uses of these simulators have received next to no R&D emphasis. It was noted above that differences in the management of simulator procurement and of instructional methods R&D usually precludes getting instructional technology designed into these devices.

Performance Measures. The whole area of performance training, and especially CGTU training, is in need of objective measures to apply during and at the end of training. Measures of team performance are especially necessary, but measures of individual performance in the team context are required as well, since it is essential to know how individual performance contributes to team success. This has been an intractable problem. The reasons seem to be the difficulties of observing the subleties of intrateam interactions, the great cost of recording data describing these interactions, the nonobvious relationships between performance processes and performance products, and the inaccessibility of teams to prolonged study and analysis.

Feedback Models. Feedback can be classified in various ways; as error-correcting, as reinforcing, as positive, as negative, etc. Several types of feedback are essential for effective training. Training managers need feedback about how well the training system is functioning to produce the desired product, so that they can make adjustments to the system. Students and teams need feedback about the adequacy of their performance. They also need feedback from the operations on equipment or on less structured interfaces, e.g., tactical situations, that verifies or indicates weaknesses in their understanding of these features.

The point is that the uses and effects of feedback in team training are likely to be subtle, diverse, and important. Despite all the attention the concept has received in the literature of learning and training, it seems not to have been analyzed in depth nor has its role in process control models of training been fully explored.

CGTU Training Effectiveness and Cost Effectiveness Measures and Models. This is an aspect of CGTU training that seems not to have, until recently, been a major concern either of the R&D or the training communities except in very gross terms. Costs of CGTU training are undoubtedly

difficult to establish. It is important to recognize, too, that a major percentage of CGTU training is not formally identified as training. It occurs during operations, and its costs are embedded in those costs. It would seem that this aspect of CGTU training will require a rather massive effort to treat successfully.

External Influences on CGTU Training. CGTU training is concerned with teaching specific individuals to work together as a team. Some teams are better than others because of the fortuitous combination of the individuals in them. Changing the specific members of a team will affect the performance of the team. This may be more critical for some teams than others, depending on the degree of interrelatedness of team members and the margins for errors in processes that affect team output. The question is, how much does the temporary nature of team membership in the services attenuate the positive effects of training. Or, to put it more bluntly, is the personnel system working against the training system? For example, an Army tank battalion commander reported 40% turnover in his tank crews every 90 days. How can he expect to reach acceptable levels of team proficiency under these conditions?

Since the training system is embedded in the personnel system, the latter's effects on the training system should be studied. Officer selection and rotation, and enlisted distribution and assignment might, in some cases, be negating or at least attenuating the effects of training, thereby either increasing the costs or reducing proficiency below levels that training otherwise could achieve. In any case, the two systems are obviously intertwined and therefore their effects on each other must be analyzed and the methods, procedures, and objectives of each must be coordinated.

To go a step further, training management, personnel management, and hardware design management should be coordinated, for maximum effective use of the available funds for producing deliverable firepower. Otherwise, these instrumentalities will work at cross purposes, and isolated training R&D, personnel R&D, or hardware R&D will be suboptimizing in its effects. The requirement, and an encouraging start in that direction, is noted in the Air Force PMS and the AFHRL descriptive approaches to coordinating training, job aids, and hardware design. Most of the representatives of the R&D community commented on this requirement to treat all of these major elements in the equation in an integrated fashion.

Process Control Models. All training, including CGTU training, has characteristics analogous to industrial processes. There are inputs, processing operations, measurements and quality inspection, feedback (as noted above) adjustments in processes and inputs, and outputs. Although the raw material, human beings, takes an active part in the processing by using its own self-organizing processes, and effects of training procedures are neither as precise nor as easy to observe as in industrial processes, it would seem that appropriate mathematical process control models and procedures could be derived from the voluminous body of knowledge on the subject, and used to gain better control over training

processes and training outcomes. This has, in fact, already been done on a limited scale in individual training controlled by computers. However, there was little or no indication in the responses from the services and from the R&D community supporting the services that there currently is systematic R&D either on CGTU taxonomy, from the standpoint of different requirements for training methods, or on the development of process control models to serve as suitable frameworks for gaining better control over team training variables. Yet, these structures are fundamental to organization, integration, and allocation of R&D resources, as well as being essential as sources of benchmark measures of progress over the years.

8.8 CONCLUSIONS

1. Technically and financially, and unlike individual training, CGTU training is embedded in the operating forces--it is the collective training of elements of those operating forces. Depending on the circumstances, what these forces do may be defined as training or as operating. Assumptions can be made that personnel learn while operating, and that operating is therefore training. This assumption is only partly true. Some members of the force may be learning while operating. Others may not be learning. This circumstances of embeddedness made it difficult to identify, for the purposes of this study, what the services do recognize as CGTU training, or to obtain corollary data on students loads and training costs. After discussions with the services' representatives, it was agreed that the scope of CGTU training would be limited to that in which a formally recognized training syllabus is used, and which is conducted in formally recognized courses. Everyone in these discussions agreed that, although this definition would make it possible to supply reliable information, it would exclude a very large training-while-operating domain--only the tip of the iceberg above water. CGTU training costs have not been included to date in the annual Military Manpower Training Reports. This results in less visibility for these costs, which must be very great by any method of reckoning.

2. CGTU training is managed differently than individual training. This is potentially inefficient because assignments, schedules, training procedures, and objectives may not be well-coordinated between the two and could result in overlap or gaps with consequent inappropriate use of training resources.

3. Despite the magnitude of CGTU training in the services, there is very little R&D on CGTU training at the present time. Also, there are marked differences among the services with regard to stated requirements for CGTU training R&D. The Army (TRADOC) is currently emphasizing the need for and importance of Training Technology R&D in this area.

4. Relatively recent advances in hardware technology, such as the laser, the digital data-processing system, and large-scale integration (LSI) of digital circuits, constitute potentials for improving some types of

CGTU training. Lasers can reduce the costs of training by providing low-cost fire-control simulators. Digital data processing systems can be used to obtain control over training processes. LSI devices can provide, through micro-processors and minicomputers, the same kind of revolutionary change in control and computational applications that they are making in the civilian sector. They offer great promise for similar impact on computer-based instruction and on certain types of simulators.

5. There is a wide range of requirements for CGTU training R&D from (a) routine but important servicing of user needs and R&D on training-system variables to (b) the generation and nurturing of bright ideas that may offer substantial improvements in performance and/or reductions in cost.

8.9 RECOMMENDATIONS

1. Initiate systematic R&D to develop a taxonomy of operational force elements (crews, groups, teams, and units), and on methods for controlling training variables in the context of process-control models. This R&D should have first priority to establish a framework for subsequent, programmatic R&D on CGTU training.

2. Establish CGTU training R&D testbeds in all four services, as cooperative efforts between R&D and user communities. Provide the necessary critical mass of recources and continuity of effort to develop more cost-effective ways of training the different kinds of operating-force elements (CGTU's) characteristic of each service.

3. Incorporate instructional technology into flight and other simulators, to improve the effectiveness of these devices for training, and to increase their utility. The Training Technology R&D elements of NPRDC and NTEC (in the Navy), of ARI (in the Army), and of AFHRL (in the Air Force), should be tasked and funded to develop the instructional technology and the delivery systems to be used with these simulators. These laboratories should also participate in the initial planning for the simulators, with the responsibility for contributing the training technology implementation and utilization plans.

4. Initiate R&D on methods for identifying the influence and interaction of the present systems for managing training, personnel, and hardware design so that they can be coordinated to prevent or reduce suboptimization effects on CGTU training and operations.

5. Organize the human resources laboratories in the services to manage Training Technology R&D centrally, with decentralized R&D operations colocated with CGTU operational training.

6. Training Technology R&D agencies in the services should examine interfaces between individual and CGTU training to improve coordination of objectives, methods, scheduling training concepts, and funding.

REFERENCES (Chapter 8)

1. U.S. Army, Navy, and Air Force responses to DSB Task Force on Technology Questions.

2. Training and Doctrine Command. U.S. Army, Memorandum for the Record, 30 January, 1975.

3. Deputy Project Manager, PM Trade, U.S. Army, Memorandum: Information for Defense Science Board, 23 December, 1975.

4. Colonel J. W. Seigle, Training in the British Army, A survey of practices that may apply to the U. S. Army in a volunteer environment, 7 March, 1973.

5. Summary description of the Mobile Integrated System Trainer, Evaluator and Recorder (MISTER) 14 November, 1974.

6. Tactical Training for Combined Arms Elements: RealTrain, TC 1-5, January, 1975.

7. Department of Defense Directive 5000.26, January 21, 1975: Defense Systems Acquisition Review Council.

8. Ltr., Marcor, 11 March, 1975; Tactical Exercise Simulator and Evaluator (TESE) and Tactical Warfare Analysis and Evaluation System (TWAES).

9. Ltr., Technical Director, Navy Personnel Research and Development Center, 7 March, 1975.

10. Memorandum, ONR Code 450, 10 March, 1975.

11. Briefing Supplement, Application of Tactical Data Systems for Training ARI, 17 December, 1974.

CHAPTER 9

GENERAL DISCUSSION*

9.1 TOPICS NOT STUDIED

The subject matter area studied by the Task Force was very broad; inevitably there was a variation in depth of study. Some subjects, such as flight simulators, were studied extensively; other matters were given less attention.

As indicated elsewhere, the Task Force did not study operational training or operations. Because of the lack of data and because the primary charge to the Task Force was to study individual training, little attention was given either of these areas although they are recognized as extremely important subjects for study with respect to training technology. Formal Crew/Group/Team/Unit Training was, of course, studied and is reported on in Chapter 8.

A related topic, "On-the-job-training," (OJT) was also considered outside the scope of the study. This again is an extremely important area with large costs, both in dollars and readiness. In one Air Force specialty for which these costs were estimated, flight maintenance specialists (AFSC431X1), OJT costs were $6000 and technical school costs for the 12-week course were $3200 per man.** Another area not given direct attention was training of the Reserve forces. Consideration of Reserve training was included in some of the substantive investigations, but there was no effort specifically oriented toward Reserve training.

Except in certain contexts, for example, flying training, where comparisons were made with commercial airline practices, no extensive study was done by the Task Force of training technology in business and industry. However, the staff did a review of the literature on training technology in business and industry, including a Navy Training Analysis and Evaluation Group (TAEG) report on commercial contract training.*** The general conclusion of the TAEG study relative to the present report was that DOD training was as progressive as most industrial training with perhaps better utilization of new training technology.

A similar literature search was made for foreign military training technology activities, including the review of a number of unclassified Soviet documents. No overall analysis was made, however, and only specific items were cited, for example, British Army training practices. Another area given only cursory attention was training technology activity in non-DOD government agencies. The activities of the Inter-Service Training

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*Thomas C. Rowan.

**Gary R. Nelson, Robert M. Gay and Charles Robert Roll, Jr. Reducing Manpower and Personnel Costs in Electronic Maintenance: Framework and Recommendations. WN-8544-ARPA. January 1974, p. 32.

***D. R. Copeland, et al: Analysis of Commercial Contract Training Orlando, Flordia: Training Analysis and Evaluation Group Report. 1974, No. 13-1.

Review Board (ITRB) and its subsidiary groups are clearly of relevance to the general subject of this Task Force, and are referred to on several occasions in the substantive chapters. The Task Force, however, did not view an overall examination of their activities as being within its charge.

Except in isolated cases, the quality of the research and of the personnel performing it were not studied in detail nor was the adequacy of research facilities. A related R&D management issue is the proper balance between in-house and contractor research. This issue was also not addressed in a comprehensive way. In fact, it was often difficult to determine short of direct questioning when research was being done in-house or by contractors. Perhaps understandably, some research managers neglected to include in descriptions of good research whether it was being done on contract or was being done by in-house laboratory staff members. This tendency is regrettable and one would wish that the system were so structured as to reward the research manager as much for recognizing and nurturing good research in the private sector as it does in rewarding him for building an in-house research organization.

9.2 GENERAL CONSIDERATIONS

A number of issues arose in more than one of the functional training areas studies by the Task Force. Some of these are peculiar to human resources research. Perhaps the most notable point here is that human resources research involves people and while portions of the research can be carried on in the laboratory, much of it requires the participation and cooperation of large numbers of field personnel. This leads to complications not always understood by research managers accustomed to the physical sciences and engineering. Training methods that have been effective in the laboratory need to be tested and evaluated in the training schools and in Operational Commands. This requires the participation of students at schools, and of officers and troops in the field in trials which, to some extent, must compete with other already scheduled activities. The way this dilemma is resolved inevitably affects the thoroughness with which new methods of training can be evaluated in realistic circumstances. It is clear that this is an area in which improvements are possible as well as desirable.

Throughout the study, the importance of incentives and dis-incentives arose. This, of course, is not unique to human resources research or, for that matter, to general research, but it is clear at least in this area that the system as it exists often leads to situations where a decision-maker's own personal interest is contrary to what is in the best interest of the government. Examples of this situation were observed among researchers, among operational commanders, training commanders and program managers. Some of the recommendations of the Task Force address this problem and more will be said about it below.

Encouraging changes are taking place with the purpose of military training. There is, for example, increasing emphasis on how well a man does a job for which he is trained rather than on how well he can answer questions about the job in a school environment. This has led to the

development of performance tests in place of verbal tests. The performance tests themselves are derived from a better understanding of what the trainee is expected to do on the job. A related matter is the emphasis on "how to train" versus "what to train." Much of the research in previous years has been on training technique. There is a growing recognition that the content of training needs more attention so that training will have a more direct relationship to where the pay-off is: performance on the job.

In each functional area studied, the problem of "institutional memory" arose. There is clearly a large amount of inefficiency and expense brought about because of the fact that DoD structure and procedures lead to ideas being lost with expensive reinvention having to take place. Part of this problem is due to military rotation policy. The Task Force on several occasions was told by military officers that certain practices were newly invented although the practices were direct derivations of earlier research and sometimes were in use in other parts of DoD. One instance of this was the Naval Academy Officer who briefed the Task Force on the Academy's CAI system being unaware that this system had grown out of early ONR sponsored research. Another reason for the institutional memory problem is reorganization. Because of frequent reorganization combined with military rotation, promising research results often are forgotten because they "fall through the crack." Also involved is the "not-invented-here" phenomenon. Innovations are rejected only to reappear later when the same pressures that originally gave rise to the change reassert themselves.

In addition to institutional memory problems there is, of course, the problem of communicating between the R&D community and the using community. R&D personnel too often write their reports for other researchers and the reports consequently either aren't understood by operations people or are rejected as being irrelevant. R&D personnel need to do a better job in communicating and they need to be more concerned about how the results of their work should be implemented.

Another finding of the Task Force was that cost effectiveness played a rather minor role in Training Technology R&D. There appear to be several reasons for this. Certainly one of the important ones is that cost data are difficult to develop and effectiveness, particularly if one deals with readiness, is difficult to measure. Training Technology R&D is two levels removed from performance in the field. It is difficult enough to evaluate an innovation in terms of training variables; relating it to field performance criteria is more difficult; but the manager needs to know more than the relative training effectiveness of the innovation. He needs to know about long-term retention and he wants answers to questions like the following: Are there additional savings after training? What costs are there attendant to implementation? What R&D will be needed to confirm the value of the change? Because of the fact that most proposed changes in training approach involve a complex of factors, it is often difficult to determine exactly what aspect is responsible for a favorable result. There have been several studies comparing the effectiveness of Computer-Aided Instruction (CAI) with conventional training courses, with the results generally being in favor of CAI; but were the results due to the mode of presentation, or were they due to the careful organization of the material

that was required for CAI? In another CAI study, unfortunately almost as an afterthought, a further comparison was made, this time between the traditional course and the CAI material presented in scrambled book form for individualized instruction. The results indicated that the scrambled book approach was about as much an improvement over the conventional course as had been the CAI approach. Clearly, research in the human resources area is difficult and untidy compared to the activities of the physical science laboratory. When one adds complex cost considerations, the situation becomes even worse, in part because there is very little econometric talent in human resources laboratories.

The general consideration discussed above played a part in all phases of the Training Technology R&D process, in requirements, in the conduct of the research and in its implementation.

The Requirement Process

Each service has a formal process for establishing and validating requirements. The emphasis of the formal process is on user-established requirements. In many cases, however, the researcher often informally creates "need" for what he wants to do. The existance of the informal process is not entirely bad; total control of R&D requirements by the user has several disturbing implications. The user is likely to consider everything in terms of his own (narrow) responsibility. For example, the recruit training commander wants to ensure maximum output from recruit training. A broader, cost-effectiveness point of view might suggest that fewer people get through initial training because of the expense, both to the government and to the individual, of later failure. Unfortunately the long-range impact of recruit training is known primarily through impressionistic and fragmentary information.

A second implication of user control of the requirement process is emphasis on short-range results -- "Do it during my watch," an understandable though regrettable attitude. A third consideration is that a strictly user-formulated requirement may not be researchable. An operational problem often needs restatement in a larger context before an R&D problem can be delineated. What, is needed, of course, is dialogue between users and R&D personnel.

A number of forces bear or should bear on requirements other than the felt needs of the user. If training R&D requirements can derive from the analysis of training as a systematic process, the resulting program is likely to be more meaningful. Additionally, the impact of new hardware acquisition and developments in other fields that may have training impact need to be considered. The fact that lasers exist and that digital microprocessors are plunging in price ought to influence, and does influence, in an informal way, the establishment of research requirements. The often disdained "a solution in search of a problem" should not be ignored.

What is needed is a close working relationship between R&D personnel and field users who understand on an operations level what the pressing problems are. The Task Force recommendation that R&D activities be colocated

with training and operating organizations is in part based on the desirability of early involvement of R&D personnel in translating operational problems into R&D questions. Colocation has another advantage related to the requirements process. It is probably fair to say that the human resources research community is not in general user oriented. There are laudable exceptions, but most of the community look in other directions for their professional rewards -- toward each other and toward the academic community with its emphasis on scientific contribution and on scholarly publications. Exposure in the field to real life problems often changes one's attitude with a shift of interest to those questions that have the potential of high practical pay-off.

9.3 IMPLEMENTATION OF RESEARCH RESULTS

Research, by its nature, does not always result in success. In the context of DoD training technology, it is fair to define success as implementation and use in the field. This problem of implementing and institutionalizing an innovation is a perplexing one, although there are numerous pressures to innovate. Some budget-related factors are a relatively level DoD budget, inflationary pressures that are forcing more careful attention to all aspects of costs, and the greater importance of manpower costs brought about by the national decisions to equalize military and civilian pay and to end the draft. More pressure derives from the energy crisis; in addition to the costs, the need for self sufficiency in energy sources is causing pressure to reduce the use of fuel in training. Also involved are command pressures, which may be an expression of the above plus other factors such as a basic concern about readiness.

The barriers to sustained implementation are many and varied. Perhaps the most pervasive is the reluctance - not unique to DoD - to change the traditional way of doing things. In addition to having traditions like other institutions, the DoD training establishment has other features that inhibit change. A general emphasis on quick-fix approaches and fluctuation in financial support often make long-range innovation difficult. The rotation policy sometimes causes an innovation to be unwanted when it finally reaches the field if command has changed. Because of previous requirements to cut costs by reducing training time and/or increasing course content, training commanders are often reluctant to interrupt their activities to experiment and validate training technology innovations. This great dependence on the cooperation of field personnel as has been mentioned earlier, is a characteristic of training research.

Clearly, good communication is needed between R&D personnel and users if implementation of research results is to occur. And, as in the requirement process, R&D personnel need to understand that implementation is vital to the long-range health of their enterprise. In the present climate, research funds must be justified by a reasonable hit rate. Everything doesn't have to be successful, but research activities that ignore the real world of operations are likely to be short-lived.

A number of factors influence whether a given training technology research result will be successfully implemented. Some of these, like the

energy crisis, are largely outside of the control of the R&D community and for that matter the user; others are not. If research addresses an urgent problem in a specific way that does not require drastic change, it is more likely to be implemented; but the results need to be presented in cost-effectiveness terms with straightforward implementation plans to facilitate the change from the old way of doing things.

A discouraging aspect of Training Technology R&D is that even the soundest idea can fail to survive unless implementation is done carefully. The "washback" to conventional practice happens all too often. Many of the factors discussed above contribute to this and the Task Force was exposed to a number of examples. Sophisticated simulators drifted into inefficient use as part-task trainers because care was not taken to design an instructional package that specified how they were to be used; exciting and cost-effective skill-training innovations were discontinued when command changed; and numerous instances have occurred where the incentive structure simply did not support sustained innovation.

Such problems caused the Task Force to consider carefully the feasibility of special organizations devoted to the "change agent" function. The Combat Arms Training Board (CATB) in the Army and the Training Analysis and Evaluation Group (TAEG) in the Navy were seen as carrying out, at least in part, this function. A major issue with the implementation of research results is funding. Should the transfer of results to the field be done with R&D money? Should the process be controlled by the user? There was agreement that R&D personnel should definitely be involved but on what basis was not as clear.

How to implement research results is not a problem unique to the DoD. In the early 1960's there was great concern about a similar problem in public education. Policy makers in the U.S. Office of Education and the Congress felt that much of the research being federally funded in education never reached the field - the locally managed public schools. A basic problem was that university professors - those doing the bulk of the research - simply were not motivated to, and often were unable to, carry results through to implementation. Recognition of this led to the creation of a number of Regional Education Laboratories under the authority of Title IV of the Elementary and Secondary Education Act of 1965 which amended the Cooperative Educational Research Act of 1954. These laboratories were supposed to be change agents; they were supposed to bridge the gap between the academic research community and the local school. The model was an appealing one: the regional laboratories would work closely with the universities and would package promising innovation for application in the field, including carefully planned periods of installation, complete with indoctrination material for the busy teachers who would have to continue after the innovators had departed.

It would be nice to be able to say that this program was an unqualified success which should be adopted by DoD. Unfortunately, the results were mixed. Although the basic intent was to facilitate implementation, the program, after the first year, had to compete for funds with the rest of the educational R&D establishment. The staffs of the regional laboratories were

largely oriented toward the values of the academic researcher. These and other factors seemingly shifted the thrust of the dwindling number of laboratories away from the implementation of research to its production, and the public schools are again left largely to their own resources so far as implementation of educational technology is concerned.

The analogy can be overdrawn, but there are lessons to be learned. One of them is that institutional arrangements are needed for bridging the gap between the R&D and user community. Concern by R&D personnel that the results of their efforts be useful and willingness of operations and training managers to accept change are important but probably insufficient. Another lesson is that funding of the implementation process has to be thought out carefully. If the funding is totally from R&D sources, the change agent will probably gradually - or not so gradually - wither away. Just how this innovation-implementation function should be funded is not clear, but the need for it is clear and is reflected in the recommendations of several of the substantive chapters of the report.

APPENDICES

APPENDIX 2-1

Individuals Who Appeared Before the Task Force

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17 March 1975

National Security Industrial Association

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MEMORANDUM OF RECORD OF MEETING WITH TASK FORCE FOR TRAINING TECHNOLOGY
OF THE DEFENSE SCIENCE BOARD
17 March 1975

This is a report of a meeting between members of NSIA's Training Group and the Task Force For Training Technology of the Defense Science Board (DSB). The meeting took place on March 17, 1975, in the conference room of the Institute for Defense Analysis, located in Arlington, Virginia. It was an open meeting, having been previously announced in the Federal Register. (See attachment for a list of attendees at the presentation.)

Background

The conference was the culmination of a series of activities which began early in 1974. During this time, various meetings were held on the subject of the possibility of developing a series of training procedures which would be equivalent to engineering specifications, and which would be used as criteria for the preparation of military training, operational, and maintenance manuals. This concept was developed from and was centered around an original paper by Mr. Andrew Klemmer of the Douglas Aircraft Company, Chairman of the LoMAC Training Operations Subcommittee, and the activities of his subcommittee.

The idea of such a development and subsequent Department of Defense (DoD) discussions was initially discussed at the West Coast meeting of NSIA in January 1974. The idea was subsequently reviewed and again discussed at the Training Group meeting in Washington, D. C., in March 1974. As a result of these deliberations the concept was considered well enough defined for discussions with outside groups and representatives of the Department of Defense were approached.

The initial contact with representatives of DoD resulted in a presentation to personnel of Director, Defense Research and Engineering (DDR&E) in April 1974. At this conference, DDR&E researchers suggested that our ideas should be presented to the Defense Science Board's Task Force for Training Technology which was then being organized. Based on these recommendations, NSIA officials

then initiated correspondence with the DSB task force chairman, Dr. Earl A. Alluisi, offering NSIA's assistance. Our offer was accepted and the presentation before the Board resulted.

Introduction

Mr. Raymond G. Fox, Chairman, LoMAC Training Group, acting as chairman of the presentation group, outlined the background of the NSIA effort. Additionally, he indicated the interest of the NSIA/LoMAC Training Group in helping the Department of Defense in their training activities in any possible way. Finally, he outlined the subjects to be presented by the group, as follows:

1. Areas of need and current state-of-the-art in training materials preparation, validation and utility.

2. Requirement for training system design criteria.

3. State-of-the-art in training technology.

4. Education.

Presentation on Training Materials and Industry Practices

Mr. Frank Johnson, Co-Chairman, Training and Technical Manuals Survey; Mr. Charles Tiene, Chairman, LoMAC Personnel Subsystems Subcommittee; and Dr. Edgar L. Shriver, Chairman, Analysis Area - TMTC Survey, presented information on the Navy/NSIA program concerning the educational level of Navy manuals. It was explained that NSIA and member companies have been working in response to a Navy request for help in adjusting the comprehension level of manuals to the level of existing and anticipated Navy technicians. The task also includes assistance in identifying and combining commonality of training materials, technical manuals, and reports.

The recommendations which have been made to the Navy were presented as recommendations to the assembled task group. Summaries of the information in study areas 1 and 2, as surveyed, were presented. The task group was informed that a serious problem exists in comprehension and that no standard industry practice could be identified in the results reported in the study. Finally, it was recommended that the DSB task group consider the same subject in terms of all aspects of training, including maintenance and operations instruction material over the life cycle of the system. It was recommended they not address themselves to the training function alone.

Copies of the specific action recommendations and reports were provided to the DSB task group.

Requirement for Training System Design Criteria

Mr. Raymond Fox described the work of the NSIA Training Operations Subcommittee. He stated that it was the recommendation of the NSIA Training Group that DSB consider writing a training system design specification for incorporation into RFP's. He suggested a format similar to that worked out by the Training Operations Subcommittee

State-of-the-Art in Training Technology

Dr. Carl R. Vest, Chairman, LoMAC Training Technology Subcommittee, reported on the programs which NSIA has been conducting in communications or technology transfer. The various regional and national meetings with the Department of Defense and advances in the state-of-the-art of training technology were described. Copies of the various proceeding documents were left with the group. The point was made that training technology has been demonstrated to be effective and that hardware presently exists. The DSB task group was asked to recognize this fact and to recommend means for the technology to be applied on wide scale.

Education

It was pointed out by several members of the team that the concepts being expressed needed to be disseminated and explained to a broad range of industry and government personnel. It was recommended that educational materials be developed and distributed, and that an in-depth education program be initiated for government and industry personnel. Such an approach would insure that the concepts were understood, universally accepted and that applications would be uniform.

Recommendations

As an overall recommendation, the Training Group proposed the following:

1. There should be increased research and development aimed toward the use of technology in instruction delivery including both procedures and systems (including technical manuals).

2. A technology systems specification should be established for the design of training systems, technical manuals, performance aids, and all aspects of instruction delivery. It should then be made mandatory for inclusion in all RFP's.

3. The Department of Defense should integrate all aspects of performance as it relates to instruction delivery in order to accomplish a priori trade-offs in manpower versus hardware. Specifically, this performance should include training and technical job performance information systems.

Raymond G. Fox

Raymond G. Fox
Chairman, LoMAC Training Group

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APPENDIX 4-1

SCOPE OF REQUIREMENTS AND COSTS FOR SPECIALIZED SKILL TRAINING

Specialized Skill Training workload data for FY 1973-78 is presented in the table on the following page.

Costs of Specialized Skill Training from FY 1974 to FY 1976T are given in the table below.

Specialized Skill Training Costs, FY 1973-197T
($ Millions)

Service	FY 73	FY 74	FY 75	FY 76	FY 7T
Army	1461.6 (518.0)	1791.0 (500.0)	1845.0 (553.5)	1867.0 (583.9)	426.4 (138.1)
Navy	777.5 (376.3)	778.9 (421.5)	862.8 (466.0)	878.9 (481.5)	219.6 (124.8)
USMC	132.3 (89.4)	157.0 (82.9)	148.3 (79.1)	155.5 (85.0)	41.1 (23.9)
Air Force	316.8 (223.7)	607.5 (220.3)	646.2 (225.7)	631.5 (235.2)	154.7 (57.6)
DoD	2688.2 (1207.4)	3334.4 (1224.7)	3507.2 (1324.3)	3552.9 (1385.6)	841.8 (344.4)

Note: Figures in parentheses show student pay and allowances included in the figures immediately above.

Total Specialized Skill Training Loads, FY 1973-1978

Service/ Component	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T	FY 1977	FY 1978
Army							
Active	57046	46039	51921	49364	39945	50891	47913
Reserve	3276	1701	3386	4600	3424	4421	4421
Natl.Guard	5846	4294	6015	5644	4870	5897	5897
Navy							
Active	44748	37199	37925	38633	37949	39842	39612
Reserve	1291	1155	1516	1165	1561	1631	1631
USMC							
Active	10910	11490	10273	10702	11272	10754	10754
Reserve	963	415	604	641	1008	685	685
Air Force							
Active	31162	30070	28078	28200	27132	27859	27862
Reserve	366	319	272	347	328	311	311
Natl.Guard	1160	657	857	1168	1340	1260	1260
DoD							
Active	143866	124798	128197	126899	116298	129346	126141
Gd/Res Tot	12902	8541	12650	13565	12531	14205	14205
DoD Total	156768	133339	140847	140464	128829	143551	140346

Only the Air Force and Navy reported utilization of lateral entry of skilled technicians. The Air Force provides for trained personnel by having personnel from skill areas related to a particular subject be given lateral courses in that subject. Training time is considerably less than that for initial skill training. Examples of Air Force lateral courses are Avionics AGE Specialist; Flight Engineer; and, Supply Systems Specialist.

Lateral entry of skilled Technicians in the Navy was utilized in an experimental program for Electronics Technicians. The program enabled the entry of personnel into complex skill areas at a level comparable to various petty officer levels. Entry was based upon successful completion of a vocational or technical school. The purpose of the program, which began in 1971, was to determine the cost benefit of lateral entry. The 79 personnel involved are currently being evaluated as to job performance.

In Navy construction battalion ratings, lateral entry is based upon specific definitions of experience required for a skill level. This program is utilized whenever there is an urgent requirement for expansion of the number of senior personnel in the ratings involved.

DESCRIPTION OF SPECIALIZED SKILL TRAINING PROGRAMS

Specialized Skill Training is the most massive and diverse of all the major categories of individual training. In the interest of clarity, the full category has been divided into the following sub-categories: Initial Skill Training (Enlisted); Initial Skill Training (Officer); Skill Progression (Enlisted); Skill Progression (Officer); and Functional Training.

Initial Skill Training (Enlisted)*

Initial Skill Training includes all formal training normally given immediately after Recruit Training and leading toward the award of a military occupational specialty or rating at the lowest skill level. Successful completion of the training qualifies the enlisted member to take a position in the job structure of the Service and to progress, through job experience, to the journeyman level.

Load data for Initial Skill Training (Enlisted) in FY 1974 through 1978 are displayed in the following table.

* This definition comes from page V-3 of the Military Manpower Training Report for FY 1976. The Navy comments: "Navy apprentice training which is a portion of recruit training is carried as specialized skill training in the MMTR."

[illegible]

Service Component	FY 1974			FY 1975			[illegible]			[illegible]			FY197[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Army														
Active	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22801	[illegible]	[illegible]
Reserve	[illegible]	[illegible]	[illegible]	14072	[illegible]	[illegible]	[illegible]	[illegible]	3210	[illegible]	[illegible]	2304	[illegible]	[illegible]
Natl.Guard	[illegible]	[illegible]	[illegible]	26040	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5652	[illegible]	[illegible]	[illegible]	1520
Navy														
Active	[illegible]	141353	20254	161251	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22668
Reserve	[illegible]	3204	[illegible]	[illegible]	[illegible]	[illegible]	4604	[illegible]	[illegible]	[illegible]	1653	1011	[illegible]	1098
USMC														
Active	[illegible]	34461	[illegible]	35041	[illegible]	[illegible]	[illegible]	[illegible]	7370	[illegible]	[illegible]	7360	[illegible]	7326
Reserve	[illegible]	[illegible]	[illegible]	2035	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1362	1239	680	[illegible]	561
Air Force														
Active	[illegible]	[illegible]	23287	[illegible]	[illegible]	[illegible]	71346	[illegible]	20494	[illegible]	20545	[illegible]	20500	20505
Reserve	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	205	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	246	254	254
Natl.Guard	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1092	[illegible]	1008	972	972
DoD Active	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31637	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gd/Res Total	9113	7446	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DoD Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*FY 1974 Army data not available due to restructuring of Army Specialized Skill Training.
**Does not include FY 1974 Army figures.

A-4-1.4

Reflecting the variety of skills required in the four services, there is a large number of courses for enlisted personnel in Initial Skill Training. Course lengths vary widely according to the complexity of the subject matter. For example, the Air Force course for electronic computer systems repairman is 280 days in length, whereas the course for security specialist takes only 36 days. The following table provides number of courses, course lengths and projected attrition rates of Initial Skill Training (Enlisted).

Initial Skill Training (Enlisted), FY 1976

	Army	Navy	USMC*	Air Force
Number of Courses	341	106	278	236
Average Course Length (Days)	62	43	76	100
Projected Attrition Rate (Percent)	9	8	10	6

*Includes courses conducted by the Navy and other Services programmed for attendance by Marines.

A sampling of the Initial Skill Training courses in each service which will produce the most graduates in FY 1976 is shown below:

Courses Producing Most Graduates, FY 1976

Service	Course Title	No. of Graduates	Length (days)
Army	Light Weapons Infantryman	24,069	56
	Field Artillery Basic	10,572	49
	Wheel Vehicle Mechanic	9,645	56
	Pioneer (Combat Engineer)	7,475	49
	Food Service Specialist	6,457	56
Navy	Apprentice Training a/	26,900	16
	Aviation Fundamentals	15,057	9
	Basic Electricity and Electronics	11,767	31
	Engineering PropulsionBasic	7,737	23
Marine Corps	Infantry Training School	10,482	34
	Basic Administrative Clerk	2,685	24
	Field Radio Operator	1,819	54
	Basic Automotive Mechanic	1,350	84
Air Force	Security Specialist	4,673	36
	Jet Aircraft Maintenance	3,219	80
	Law Enforcement Specialist	2,639	36
	Inventorh Management	2,448	51

a/ Apprentice Training is composed of fundamental training in one of four basic skill areas: Seaman, Fireman, Airman, Constructionman. The course length shown is the average for those four skills.

Skill Progression Training (Enlisted)

This sub-category covers skill training received by enlisted personnel subsequent to Initial Skill Training. Through this training, the student gains the knowledge to perform at a more skilled level or in a supervisory position. Skill Progression Training is most frequently given after the service member has gained experience through actual work in his specialty. In some cases, however, training in a relatively narrow subject area as an immediate follow-on to Initial Skill Training is included in Skill Progression Training. The requirement for Skill Progression Training arises from the fact that training in a skill at entry level and subsequent experience do not , in many cases, fully qualify a service member to do the more advanced jobs in his field without further formal training.

Training load data for Skill Progression Training (Enlisted) for FY 1974 through 1978 are shown in the following table.

TRAINING INPUTS, OUTPUTS, LOADS, SKILL PROGRESSION TRAINING (ENLISTED) FY 1974-1978

Service/ Component	FY 1974*			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army														
Active	0	0	0	29940	27,844	4943	30756	28603	4834	7731	5821	4034	4988	4692
Reserve	0	0	0	2233	2,077	549	2784	2589	738	738	556	352	684	684
Natl.Guard	0	0	0	2416	2,247	433	2788	2593	485	792	596	456	537	537
Navy														
Active	71795	66196	9444	69957	66064	9409	72259	68199	10734	18464	17474	10876	18802	9971
Reserve	1102	1296	82	1255	1298	75	1455	1389	145	351	335	161	140	63
USMC														
Active	4951	4778	1471	4063	3,975	959	4500	4313	981	1557	946	1280	981	981
Reserve	658	653	46	740	739	53	729	728	57	634	628	120	57	57
Air Force														
Active	57746	55279	4971	51597	60,632	5249	67023	65959	5691	16151	15461	5416	5406	5406
Reserve	1181	1141	42	829	814	37	755	742	34	251	246	48	33	33
Natl.Guard	2467	2071	145	4034	3,531	227	3897	3396	215	1167	1147	260	215	215
DoD **														
Active	134492	126253	15886	165557	158515	20560	174538	167074	22240	43903	39702	21606	22177	21050
Gd/Res Total	5408	5161	315	11507	10626	1374	12408	11437	1674	3933	3508	1397	1666	1589
DoD Total	139900	13144	16201	177064	169141	21934	186946	178511	23914	47836	43210	23003	23843	22639

*FY 1974 Army data not available due to restructuring of Army Specialized Skill Training.
** Does not include FY 1974 Army figures.

The following table displays statistics in Skill Progression Training in each of the services for FY 1976.

Skill Progression Training (Enlisted), FY 1976

	Army	Navy	Marine Corps a/	Air Force
Number of Courses	87	1388	218	1600
Average Course Lengths (Days)	63	52	74	32
Projected Attrition Rate (Percent)	7	6	4	2

a/ Includes courses conducted by the Navy and other services programmed for attendance by Marines.

The large number of Navy and Air Force courses is a reflection of the technical nature of these services and their large number of sub-specialties. Of course, some of the difference is attributable to differing service approaches to course definition and segmenting.

Initial Skill Training (Officer)

As a general rule, Officer Acquisition Training is oriented toward the broad educational background and general military training which is considered necessary for all officers entering a service. In consequence, most newly commissioned officers require training for the specific types of duty they will be performing in their first duty assignment. Initial Skill Training for officers is, therefore, analogous to Initial Skill Training for enlisted personnel -- both provide the job-oriented training which, added to the military fundamentals learned earlier, prepares the individual for taking a place in the job structure.

Load data for Initial Skill Training (Officer) for FY 1974-1978 are displayed in the following table:

Training Inputs, Outputs, Loads, Initial Skill Training (Officers) FY 1974-78

Service/ Component	FY 1974* Input	FY 1974* Output	FY 1974* Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Army														
Active	0	0	0	10312	10209	2029	9267	9174	1864	3720	2939	1740	1870	1910
Reserve	0	0	0	508	503	75	933	924	154	410	324	132	158	158
Natl.Guard	0	0	0	1370	1356	311	1209	1197	274	449	355	272	280	280
Navy														
Active	2968	2831	622	3848	3486	844	3937	3578	896	1137	1039	916	897	897
Reserve	942	899	83	1102	1081	112	1080	1060	105	263	260	93	99	99
USMC														
Active	3750	3796	1206	3657	3061	1277	3744	3855	1410	996	1726	1524	1552	1552
Reserve	21	21	6	24	24	7	25	25	8	11	5	16	8	3
Air Force														
Active	5101	5097	826	5471	5337	1044	5577	5518	1102	1368	1378	1108	1102	1102
Reserve	68	64	6	18	18	2	15	15	2	5	5	-	2	2
Natl.Guard	152	146	25	160	150	27	150	148	26	37	36	20	24	24
DoD														
Active	11819	11724	2654	23288	22093	5194	22525	22125	5272	7221	7082	5288	5421	5461
Gd/Res Total	1183	1130	120	3182	3132	534	3412	3369	569	1175	985	533	571	571
DoD Total	13002	12854	2774	26470	25225	5728	25937	25494	5841	8396	8067	5821	5992	6032

*FY 1974 Army data not available due to restructuring of Army Specialized Skill Training.
**Does not include FY 1974 Army figures.

With minor exceptions, all newly commissioned Army officers attend an officer basic course at their branch school - Infantry officers at the Infantry School, Engineer officers at the Engineer School, etc. Most of these courses are 12 weeks in length, and the officer attends before reporting to his first unit of assignment. In addition, certain officers are selected to attend follow-on skill or functional training courses for more specialized assignments.

All submarine and nuclear officers and above 50% of Surface Navy officers go to Initial Skill Training. The Navy provides 17 courses for officers in Initial Skill Training, with an average length of 99 days. Most of the courses are essentially indoctrination courses or courses in specific duties, such as in antisubmarine warfare, which a junior officer may be destined to assume aboard ship.

All newly commissioned Marine Corps officers attend a basic course (28 weeks in length for male officers, 10 weeks for female officers) for general orientation and training. In addition, Marine officers attend 61 Initial Skill Training courses (some conducted by Navy or other Services), average 74 days in length, related to specific officer jobs.

The Air Force conducts 54 Initial Skill Training courses for officers, with an average length of 87 days; about 45 percent of newly commissioned officers attend these courses.

Skill Progression Training (Officer)

Skill Progression Training for officers is, in general, aimed at officers with several years of practical experience and provides them knowledge needed to assume more advanced responsibilities. For example, the Army provides advanced courses which are structured to prepare the students for battalion and brigade duties in addition to command responsibilities at the company and battery level. Data for Skill Progression Training (Officer) are displayed in the following table:

TRAINING INPUTS, OUTPUTS, LOADS, SKILL PROGRESSION TRAINING (OFFICERS), FY 1974-1978

Service/ Component	FY 1974* Input	Output	Load	FY 1975 Input	Output	Load	FY 1976 Input	Output	Load	FY 197T Input	Output	Load	FY 1977 Load	FY 1978 Load
Army														
Active	0	0	0	8881	8792	3534	8755	8668	3278	2728	2278	3192	3373	3373
Reserve	0	0	0	2389	2365	202	3069	3038	254	869	726	256	261	261
Natl.Guard	0	0	0	1814	1796	275	1977	1957	266	564	471	268	275	275
Navy														
Active	7622	6968	877	8124	7850	1084	8441	8102	1206	2351	2251	1172	1090	1090
Reserve	167	170	7	175	169	9	140	134	6	40	37	8	7	7
USMC														
Active	596	589	200	480	480	133	530	530	165	236	138	200	165	165
Reserve	74	74	4	83	83	5	68	68	5	67	67	16	5	5
Air Force														
Active	8076	7843	581	8256	8147	524	8582	8468	544	2010	1984	480	510	510
Reserve	343	335	12	401	397	14	350	347	12	117	116	16	12	12
Natl.Guard	407	399	16	1154	1137	44	1049	1033	40	261	257	40	40	40
DoD **														
Active	16294	15400	1658	25741	25269	5275	26308	25768	5193	7325	6651	5044	5138	5138
Gd/Res Total	991	978	39	6016	5947	549	6653	6577	583	1918	1674	604	600	600
DoD Total	17285	16378	1697	31757	31216	5824	32961	32345	5776	9243	8325	5648	5738	5738

* FY 1974 Army data not available due to restructuring of Army Specialized Skill Training.
** Does not include FY 1974 Army figures.

The Army conducts 16 branch-oriented courses, most of which are 32 weeks in length. The Navy maintains 135 courses, averaging 51 days in length, which cover a variety of specialized duties which are typically performed by officers with several years of service -- for example, destroyer officer course, aviation maintenance officer course, and nuclear propulsion plant course.

Both the Marine Corps and the Air Force conduct broad courses for officers at about the same level as the Army's advanced courses; however, as these are Service-wide and uniform in content, they are carried in Professional Development Education. Within Skill Progression Training, Marine Corps officers attend 85 courses, with an average length of 104 days, on a variety of specialized subjects, some conducted by the Navy or other Services. The Air Force has 550 courses, averaging 23 days in length, for the purpose of training officers in new duties required by their prospective assignments.

Functional Training

Functional Training is an "all other" sub-category covering those types of required training which do not fit neatly into the definitions of the other sub-categories. By and large, Functional Training is in subject areas which cut across the scope of military occupational specialties and provides additional required skills without changing the student's primary specialty or skill level. Both officers and enlisted personnel participate in Functional Training. Load data for FY 1974-1978 are shown in the following table:

Training Inputs, Outputs, Loads, Functional Training, FY 1974-1978

Service/ Component	FY 1974* Input	FY 1974* Output	FY 1974* Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Army														
Active	0	0	0	65681	62879	8749	70196	67190	8214	17645	13232	8088	8217	8217
Reserve	C	0	0	4721	4610	243	4318	4196	244	2080	1561	380	266	266
Natl.Guard	0	0	0	3566	3447	362	3841	3737	273	1055	792	287	285	285
Navy														
Active	357068	345723	4409	337066	331608	4228	346448	340208	4204	87445	85445	4186	4152	4152
Reserve	11461	11536	292	11763	11280	216	14654	14306	291	3990	3848	288	287	287
USMC														
Active	7423	6197	836	7252	6127	665	7336	6169	776	2124	1342	908	730	730
Reserve	1230	1230	46	1383	1383	54	1396	1396	54	1271	1250	176	54	54
Air Force														
Active	19198	19169	405	16866	16654	354	17026	16880	369	4018	3960	344	341	339
Reserve	1042	1059	21	716	707	13	578	560	13	190	189	16	10	10
Natl.Guard	404	397	9	460	452	11	400	396	10	100	100	12	9	9
DoD **														
Active	383689	371089	5650	426865	417268	13996	441006	430447	13563	111232	103979	13526	13440	13438
Gd/Res Total	14137	14222	368	22609	21879	899	25187	24591	885	8686	7740	1159	911	911
DoD Total	397826	385311	6018	449474	439147	14895	466193	455038	14448	119918	111719	14685	14351	14349

* FY 1974 Army data not available due to restructuring of Army Specialized Skill Training.
**Does not include FY 1974 Army figures.

Army Functional Training includes the airborne, ranger, and special forces qualification courses, some specialized NCO supervision courses, and a number of courses related to specialized equipment (e.g., Manual Cordless Switchboard Repair; 8-inch Atomic Projectile Assembly).

Navy Functional Training differs from that of the other Services because of the very high input to a large number of very short courses (the longest is 12 days, the shortest is one day). Most of the training consists of in-port training for ships' crews, and includes the following types of activity:

1. Shore training for shipboard teams (firefighting, damage control, anti-submarine warfare, etc.).

2. Short basic or refresher courses at fleet training centers in the operation of equipment or systems.

3. Shipboard in-port training assistance.

4. Precommissioning training for newly formed crews of ships under construction.

Marine Corps Functional Training provides skills required for specific jobs but not limited to a primary occupational specialty. Some of the included courses are scuba training, seaduty indoctrination, and drill instruction training.

Almost all Air Force Functional Training is survival training related to various environments: water, arctic, jungle or topic.

The following table provides additional statistics on Functional Training.

Courses and Course Lengths, Functional Training, FY 1976

	Army	Navy	Marine Corps a/	Air Force
Number of courses	159	1,566	191	8
Average Course Length (Days)	56	4	37	7

a/ Includes courses conducted by the Navy and other Services programmed for attendance by Marines.

Major changes in the Navy since FY 1972 have been:

1. Closure of NTC Bainbridge for better utilization of newer physical plants and consolidation of training for billet and O&MN Savings.

2. Concentration of "soft skills" in clerical and administrative training at a central location in Meridian, Mississippi. The consolidation permits more efficient utilization of common type equipment and personnel resources.

3. Consolidation of training sites so as to shorten transportation requirements. For example, electronic technician training at San Diego, formerly at Treasure Island, is in the same geographical location as recruit and prerequisite basic electricity and electronics training.

Since 1972, the Army has undergone a process of reviewing Specialized Skill Training programs as to their applicability to the Army's needs. In situations where identical courses were taught at several locations, reduction in requirements and economic necessity have caused consolidation to one training site. For example, Aviation training, once conducted at both Fort Rucker and Fort Wolters, has been consolidated at Fort Rucker. Much of the signal oriented training, previously at Fort Monmouth, is now at Fort Gordon. Also, Army branch oriented training centers at Fort Bliss (Air Defense Artillery), Sill (Field Artillery) and Gordon (Military Police) have been merged with branch schools.

Courses have been increased or terminated in response to changes in requirements. Combat support training at Forts Knox and Polk has been terminated,as has cook and clerk courses at Fort Leonard Wood. Combat support training at Fort Jackson has been increased to compensate for the course closures at the other bases.

In the period of FY 1972-1975, the number of Specialized Skill Training courses in the Air Force was reduced by 337. Most of the reductions were in Special Resident and Special Field Training courses. An additional 52 courses were programmed in the Regular Resident training program. In the same time period, the weighted average course length was reduced from 9.2 weeks to 8.0 weeks. In Initial Skill Training, airmen courses were increased from 179 to 199, but weighted average course length was reduced from 15.6 weeks to 13.6 weeks. Officer courses in Initial Skill Training have stayed rather constant with the weighted average course length going from 14.6 to 12.6 weeks.

APPENDIX

TECHNOLOGY COORDINATION PAPER

HUMAN RESOURCES

DEPARTMENT OF DEFENSE

OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
ENVIRONMENTAL AND LIFE SCIENCES
WASHINGTON, D. C. 20301

30 MARCH 1973

F. Priorities.

The Services and Defense Agencies have identified the current R&D efforts which represent the 1/3 of their respective programs which is of top priority in the Human Resources Technology Area. These programs are identified by Service and Defense Agency.

ARMY: The top priority efforts are: design of education/training media, trainee evaluation, training technology applications to special problems, recruiting, selection and classification, race relations, drug abuse, man-machine systems and human performance capability and adaptability.

NAVY: The major program thrusts support priorities established to improve the efficiency and effectiveness of education and training; total force level planning for active duty, reserve and civilian personnel; reduction in shipboard manning requirements; and the full range of "manpower crisis" problems in drug abuse, race relations, and discipline. These priorities derive primarily from the problems associated with the overall reduction of DoD resources, the new environment of the zero-draft, and the changing cultural characteristics of the population from which future DoD manpower requirements will be met.

AIR FORCE: The top priority items are the Advanced Simulation in Undergraduate Pilot Training (ASUPT), the Advanced Instructional System (AIS), and Fully Proceduralized Job Performance Aids (JPA), in support of training needs, and the Occupational Analysis program, which has impact on many of the Air Force personnel and training systems.

ARPA: The following are the top priority programs; training technology, quantitative strategic forecasting, computer simulation of crisis decision problems, manpower models, and man-machine systems.

OASD/M&RA: The top priority program is manpower recruiting.

APPENDIX 4-3

The Army's Computerized Training System (CTS) project is designed to field an operational Computer Assisted and Computer Managed Instruction (CAI/CMI) system at Ft. Gordon, Georgia. Although the system will initially be used for training in communications and electronics, it is expected that it will serve as a model for similar systems in special skill training. Currently, the first 32 of the planned 128 terminals have been installed, and the system is expected to be fully operational by August, 1975.

The CTS project began in 1971, and consisted of three major phases. The first phase employed an existing off-the-shelf CAI system, the IBM 1500 series, to evaluate the potential of CAI for Army skill training. Results showed a potential 25-30 per cent reduction in training time, and in general, were favorable towards the introduction of CAI into Army training. The second phase consisted of determining the design requirements and hardware/software specifications for an Army CAI system. Portions of this effort involved the use of the PLATO CAI system to evaluate the utility of plasma type terminals. Additional support was provided by project IMPACT which resulted in design recommendations, many of which were incorporated in the final system design requirements. ARI active participation included project CATALIST which consisted of development of an instructional model for CAI and software development of an interactive graphics terminal. CATALIST is scheduled to terminate 30 June 1975.

Over the next five years, it is expected that the CTS project will provide guidance and integration of all Army CAI/CMI efforts. ARI will assume a major technical support role, including the use of the first CTS system (ABACUS) as a test bed to evaluate new technology in computer instruction.

The Navy plans to develop a CMI system which will perform the test evaluation and instructional strategy for each student individually within certain designated schools. These schools are, in general, those with AOB's greater than 500 and cover a spectrum of skills including aviation maintenance, marine propulsion, basic and advanced electronics and certain clerical skills. The proposed system will aid the individualized training of 5000 (average of board) officers and enlisted personnel in technical and specialized areas and must be expandable to support an average on board student enrollment of about 16,500 students.

NPRDC has developed and evaluated a number of CBT applications, including Computer Management of Aviation Fundamentals Training, IBM 1500 applications in the training of Basic Electricity and Electronics, and the various sub-projects under the PLATO IV technology program.

The Air Force PLATO IV program being funded through ARPA as a part of a tri-service effort is being conducted to determine the feasibility of CAI in Air Force Technical training.

Another Air Force CAI effort which is now implemented is the Computer Directed Training System (CDTS) which is now implemented, but began as a feasibility study several years ago. The approach was to provide OJT to personnel using a B3500 computer in their jobs (e.g., personnel specialists). CAI programs were used to train personnel on a time-sharing basis with existing computer capabilities. The evaluation demonstrated that this application to OJT was feasible and cost-effective. The program is now operational world-wide where a base level B3500 is used for personnel support. Areas of instruction now operational or projected to be completed in the near future are:

B3500	H6000
Computer Operation	COBOL & FORTRAN Compiler Languages
Base Level Military System	Terminal Users
Advanced Personnel Data System	Time Sharing
Civilian Personnel Mgt Info Sys	JOPS*
Terminal Opns for Acctg & Finance Personnel	Introduction to H6000*
Joint Uniform Pay System	Systems Analysis*
Base Engineer Automated Mgt Sys	Operations*
COBOL & FORTRAN Compiler Languages	IDS*

*Completion date 2/3 Qtr CY 1975

APPENDIX

Army R&D has successfully demonstrated in two automated instructional packages the feasibility of Application of Tactical Data Systems (Embedded Training) for meeting user training requirements in a tactical unit environment. One package assisted infantry personnel in preparing for job proficiency tests in Crew Served Weapons and Tactics and the other was for General Educational Development (GED) for those personnel who had not met high school equivalency requirements.

For both job proficiency and GED, the automated instruction was more effective than self-study methods. Not only was performance for the automated instruction group higher than for other methods of training, automated instruction was also effective across the range of general mental abilities.

Possible applications of embedded training are: (1) Administration of automated instruction MOS courses for familiarization training in TO&E units. Advanced Individual Training (AIT), and preparation for MOS proficiency tests: (2) Use by National Guard and Army Reserve forces. Such courses may be particularly effective in Infantry units, especially alert units, primarily to increase and maintain combat proficiency.

TAEG REPORT NO. 13-1

SUMMARY

INTRODUCTION

Approximately 8 per cent (110 billion dollars) of the Gross National Product is devoted to national education. It was estimated that 6.6 billion dollars of the total national expenditure would be expended in FY 1974 by the DoD (Department of Defense) for training and education.[1] Even though the cost of training continues to increase, inflation continues to increase and manpower reductions continue; the Navy is forced to reduce their training costs to meet the current austerity requirements. Furthermore, these training cost reductions must be achieved with no adverse effects on the continuing efforts to improve the quality of Navy training.

Throughout the military services and the civilian sector, various alternatives are being explored, developed, and often discarded, to improve training quality while simultaneously reducing training costs. An alternative which has been explored and should be developed and not discarded is the concept of using commercial sources to train Navy personnel in selected basic skill areas. The task of exploring the feasibility of this alternative was assigned to the TAEG by the CNET. The Phase I (exploring) element of the task was concerned only with utilizing commercial sources for Navy selected basic skill training, the results of which are documented in this report. The Phase II (developing) portion of the task will be concerned with implementation of the concept for selected Navy and Marine Corps skill training.

The two-phase study includes both industry and public and private vocational/technical training institutions. Non-industry

1/ U. S. News and World Report, June 18, 1973

training institutions are referred to as VOTECS. The study included personal examination of 30 industrial organizations. (The National Security Industrial Association provided data on 50 additional companies.) The examination of VOTECS concentrated on states having large Navy installations.

Most of the data for this study were collected during personal visits to industrial organizations and vocational-technical training institutions and by review of appropriate literature. Discussions with training personnel and direct observation of training in classrooms, facilities and equipment provided invaluable data.

CONCLUSIONS AND RECOMMENDATIONS

A summary of the major conclusions and recommendations of the Phase I Staff Study is presented below.

CONCLUSIONS

1. Industry and non-federal post-secondary training institutions have the capability and facilities to provide effective training to Navy enlisted personnel in basic technical and vocational skills. Contract training with these sources in selected skills provides an opportunity to greatly expand Navy training capability by providing technical training programs to supplement present Navy training, to eliminate costly duplication of existing civilian facilities, and to provide specialized training not offered by Navy schools.

2. The systems approach to training is widely used by industry and non-federal post-secondary training institutions in the development of training programs.

3. Industry recognizes the value of, and need for, cost effective in-house training and is applying innovative educational techniques to meet their training needs.

4. Public and private, non-federal post-secondary training institutions develop training programs to meet the specific needs of the community. Navy utilization of such institutions should be carefully considered since a disproportionate number of military students could adversely affect the civilian-military relationship.

5. Civilians trained in selected skills by non-federal post-secondary institutions can meet Navy "A" school level graduation requirements.

6. Many public area vocational/technical schools and junior/community colleges have established effective feedback systems which enable the user of their product (the trained student) to report changes in occupational training institutions to revise curricula as necessary to keep pace with technological advances.

7. The concept of commercial contract training does not require changes to the ASPR.

8. In general, both industry and non-federal post-secondary vocational/technical training institutions are receptive to the concept of conducting training for Navy personnel at the "A" school level and will tailor training programs to meet the specific needs and standards of the Navy.

9. The application of cost effectiveness and cost benefit analysis throughout the training program development cycle is an accepted practice in industry. Substantial cost savings can be achieved through utilization and refinement of such techniques in the Navy training system.

10. Only those commercial sources physically located within reasonable commuting distance of the students' assigned base should be considered for training military personnel at the "A" school or apprentice level.

11. Government and industry accounting systems are not structured to enable the determination of the true cost of training. A standard accounting system specifically designed to represent the true cost of training is required.

12. Industry has significantly increased the flexibility and capability of training facilities through the incorporation of advanced design concepts. Such concepts have proven effective in reducing maintenance and modification costs.

13. There is a trend within industry to centralize training management control within the corporate structure. Many of the management practices and philosophies of industry have beneficial application to the Navy.

14. The majority of industrial activities develop career professional educators and instructors, advancing qualified personnel on merit to management level positions.

15. Personalized training programs in being and under development in the civilian sector have application to Navy development and planning.

16. Those industrial activities that have long-range training plans and strategies have the most effective training programs.

17. Standardization of training facility design, instructional equipment, instructional techniques, and training curricula is a standard practice within industry.

18. Instructors in industry are required to attend professional instructor training courses prior to classroom instruction.

19. Commercial training sources have the capability and facilities to provide training to Naval Reserve personnel. Such sources should be considered in mobilization planning.

20. Commercial training sources require evaluation on an individual and competitive basis due to the lack of standardized criteria for goal achievement in the area of technical skill training.

21. Industry is experimenting with, and using, many advanced education and training concepts to improve the effectiveness and efficiency of training.

RECOMMENDATIONS

A. Management

1. The CNET should continue to support efforts directed toward centralized training management. This philosophy is accepted in industry as the most efficient means of achieving positive program control, training program continuity, training effectiveness, training efficiency, training standardization, training cost reductions and effective program planning.

2. A full-time staff activity responsible for long-range planning strategy should be established by CNET. The functions of this staff should include as a minimum:

a. The impact of foreign national policy on Navy training.

b. The impact of DoD policy on Navy training.

c. The impact of new weapon systems on Navy training.

d. The application of long-range R&D efforts in education and training technology to Navy training.

3. Continued effort should be devoted to the standardization of education and training technology. This should include all facets of education and training.

4. The CNET should continue efforts to consolidate education and training facilities. Such consolidation effort should include consideration of the current efforts being devoted to the concept of interservice training.

5. The efforts being devoted by the CNET to improve communication channels through exchange of training and education data between subordinate commands, other services, and civilian activities should be continued.

6. The CNET should initiate a program to simplify the RMS (Resource Management System) to effect maximum utilization of personnel and equipment in its training programs.

7. Continued effort should be directed toward the centralized control of training and education research and development programs.

8. The CNET should adopt standardized task analyses methods. Administrative procedures and appropriate guidelines should be established to insure that task analysis is applied during the acquisition of all new weapon systems and platforms and during all training development programs.

9. The CNET should continue efforts, within the areas examined in this study, toward interservice training and the use of appropriate DoD agency schools to satisfy Navy basic skill training needs. Progress in this area will result in training cost reductions for the Navy and increased training management efficiency.

10. Emphasis should continue to be placed on the development of an effective Navy-wide feedback system for education and training. An

effective feedback system, accepted by all Navy commands, will greatly increase the efficiency and effectiveness of Navy training.

11. A career field relating to education and training should be established for Naval officers, enlisted, and civilian personnel. This career field is required to elevate the professional status of Navy education and training personnel and to maintain the program continuity of all training and education activities.

12. The current effort being devoted to improving instructor training techniques and methodology should be continued. The concept of classroom managers should be included in instructor training curriculum. Consideration should be given to mandatory periodic refresher instructor training to keep Navy instructors abreast of the latest changes in training technology and instructional techniques.

14. Continued effort should be directed toward the standardization of training and education terminology. This effort should be considered by personnel charged with the responsibility for interservice training and education.

15. Procedures should be established to realign techniques for inspection and evaluation of Navy training programs. Such procedures should be specific in nature to permit meaningful evaluation of the effectiveness and efficiency of training programs.

16. A standard technique for economic analysis should be established for the education and training community. This technique should be based on the basic economic analysis concepts set forth in Section VII of this report.

17. The CNET should continue efforts for the certification and accreditation of Navy skill and technical training courses.

18. Continued effort and growth should be encouraged for the standardization of training aids and devices. The effort being devoted to consolidation and standardization within the cognizance of the CNETS closely parallels the consolidation and standardization philosophy of many industrial organizations.

19. The CNET should consider the utilization and application of the concepts set forth below in appropriate Navy training situations:

a. Cognitive style mapping

b. Managed on-board training vs. on-board training (e.g., formalized control vs. non-formalized control)

c. Shipboard satellite training

d. CAI remedial education

e. Civilian recognized Navy training certificates

f. Motivation as a major education and training consideration (e.g., this includes job induced (extrinsic) as well as such intrinsic motivation as attitudes and incentives to perform).

g. Modular structured courses (increased emphasis).

20. The CNET should consider non-federal post-secondary training institutions as training sources in mobilization planning.

21. Non-federal post-secondary training institutions should be considered as sources for appropriate Naval Reserve training. These institutions are curently being used for certain types of Marine Corps Reserve training.

22. The CNET should establish programs to improve the classification procedures for new personnel.

PHASE II PLANS

The Phase II portion of this study will provide two VOTECS implementation plans, one for the Navy and one for the Marine Corps. The Navy plan will be completed in February 1975 and will include the following:

1. Sample VOTEC specification
2. Program of instruction for LI (Lithography) rating
3. Economic analysis techniques applicable to Navy and Marine Corps in-house training and for proposed commercial contract training
4. Management consideration and contract training feasibility programs
5. Contractual techniques for commercial contract training
6. List of qualified VOTEC institutions near Navy installations
7. Comparative cost analysis

APPENDIX 4-6

Sample HumRRO Training Research Studies Which Demonstrated Improved Proficiency or Decreased Training Costs or Both

Selection and Commentary by

W.A. McClelland
Human Resources Research Organization

A handout for the Defense Science Board's Task Force on Training Technology, January 22, 1975.

Aviation Training

Code Name: AVTRAIN

Dates of Study & Reference: 1969-1974

Isley, R.N., Corley, W.E., Caro, P.W., "The Development of USCG Aviation Synthetic Training Equipment and Training Programs," HumRRO Final Report FR-DC-74-4, October 1974.

Findings: After introduction of simulation in three helicopter training and qualification courses a savings in excess of $700,000 was estimated when compared with 1969 costs of this training.

Field Tested: No. The simulator and training program were made operational immediately.

Implemented: Yes. See finding above.

Potential/Actual Benefits: By eliminating the HH52A and HH3F proficiency courses and substituting the VCTS (Variable Cockpit Training System) an additional savings of 854K could be realized with no expected loss in proficiency. Reduced aircraft accidents and increased availability of aviators for mission assignments might also be anticipated.

Comment and Interpretation: This highly successful program was distinguished both by a history of HumRRO simulation research for the Army and by close and continuous Coast Guard-HumRRO cooperation from the initial statement of the requirements through the actual installation of the training program. The initial USCG project officer stayed with the program until the VCTS was actually operating at the USCG Aviation Training Command.

Aviation Training

Code Name: SYNTRAIN

Dates of Study & Reference: 1970-1972

Caro, P.W., "Transfer of Instrument Training and the Synthetic Flight Training System," HumRRO Professional Paper 7-72, February 1972.

Caro, P.W., "Aircraft Simulators and Pilot Training," reprint from Human Factors, Vol. 15, No. 6, 1973, HumRRO Professional Paper 6-74, May 1974.

Findings:

Equipment	Original Program	New Program	Savings
UH-1-H aircraft	60.0 hrs.	6.5 hrs.	53.5 hrs.
1-CA-1 trainer	26.0		
2-B-24 trainer	____	43.0	____
Total Training	86.0 hrs.	49.5 hrs.	36.5 hrs.

Flight time reduced 89%; overall training time reduced 42%; 2-B-24 transfer effectiveness ratio 1.24.

Field Tested: Yes.

Implemented: Yes. Simulators installed and operational at the Army Aviation School, Ft. Rucker, Alabama and additional buys for field locations are in process.

Potential/Actual Benefits: "Initial feasibility studies conducted by the Army in 1966, estimated that a high quality simulation system could reduce instrument training hours from fifty to forty, i.e., ten hours would be accomplished by use of a simulator instead of high cost operational aircraft. The resultant net savings in flight training costs over a one-year period at Fort Rucker alone would be approximately $1,711,000. Through this actual flight time reduction, forty-seven helicopters, valued at more than $10,000,000 could be made available for other uses." U.S. Army Materiel Command News Release, dated 9 June 1969.

Comment and Interpretation: This highly successful program was distinguished by close and continuous Army and HumRRO cooperation from the initial statement of the requirements through the actual validation of the training program using the new simulator.

Armor Training

Code Name: UNIT

Dates of Study & Reference: 1959-1961

Baker, R.A., Cook, J.G., Warnick, W.L., and Robinson, J.P., "Development and Evaluation of Systems for the Conduct of Tactical Training at the Tank Platoon Level," HumRRO Technical Report 88, April 1964.

Findings: All the groups of subjects that received the experimental training on either the Minature Armor Battlefield (MAB) or the Combat Decisions Game made significantly higher scores on the field performance test than comparable groups not so trained. Inexperienced experimental groups performed as well as did a group of experienced tank platoon leaders.

Field Tested: No.

Implemented: "USCONARC has recommended to the US Army Materiel Command that the Combat Decisions Game, developed under Task UNIT as a research vehicle for the investigation of tank platoon leader and tank crew training, be incorporated into the Drawings for Army Training Aids (DATA) program. The Combat Decisions Game is an easily constructed training device which is to be used in conjunction with a set of detailed training exercises that will accompany each set of construction plans. These training exercises have been shown to effectively prepare tank platoon personnel for field training with operational equipment. Specifically, the Combat Decisions Game has been shown to be most effective in training in the following areas:

(1) Coordination and reporting of combat information.
(2) Analysis and use of terrain.
(3) Command and control.
(4) Application of tactical principles.
(5) Target designation and tank fire control."

CONARC Pamphlet No. 70-12, October 1963.

"Armor training. Following the development and evaluation of the Miniature Armor Battlefield under Task UNIT at the US Army Armor Human Research Unit, USCONARC surveyed the ZI armies and determined that six devices are needed for training of CONUS units. Department of the Army surveyed overseas installations and determined that eight such devices were needed by overseas units. Requirements for the manufactured components of the battlefield have now been forwarded by USCONARC." CONARC Pamphlet No. 70-1, January 1965.

Potential/Actual Benefits:	Training costs can be lowered with no proficiency loss; the training devices can be substituted for some field tactical training as in reserve units and where maneuver area facilities are restricted. In an extension of the study to the armored cavalry platoon (Task RECON), an armored cavalry trainer and user's manual were developed together with proficiency checks, a platoon leader's workbook and programed instructional materials on the M-73 machinegun. "In addition to the trainer located at the US Army Armor School, Fort Knox, Kentucky, installations are in progress at Akron, Ohio, for the Ohio National Guard, one at Camp McCoy, Wisconsin; and one at Fort Leonard Wood, Missouri. The combat readiness check and the platoon leader's workbook currently are being given a field evaluation by USAREUR. The pictorial instruction program for the M-73 machinegun was developed to demonstrate a self-instructional technique for developing the skills necessary for disassembly and assembly of weapons. Evaluations of this program have shown it to be highly effective. The training package developed under Task RECON could well serve as a model for the development of similar packages for the on-the-job training of small units. The pictorial programed instructional method of training is particularly well suited for training in individual weapons." CONARC Pamphlet No. 70-1, February 15, 1967.
Comment and Interpretation:	Research products were used extensively from this programatic, developmental effort. User support was strong. Procurement actions, however, were slow for the MAB, thereby reducing potential benefits.

Armor Training

Code Name: SHOCKACTION VI

Dates of Study & Reference: 1957 - 1958

MacCaslin, E.F., Woodruff, A.B., and Baker, R.A., "An Improved Advanced Individual Training Program for Armor," HumRRO Technical Report 59, December 1959.

Findings: An experimental six (6) week Advanced Individual Training program proved to be more economical in time and cost, with a somewhat higher level of trainee proficiency at the end of training than the conventional eight (8) week program.

Field Tested: Yes.

Implemented: As of January 1960 the following actions had been or were being taken:

"Implications of Public Law 51 prohibit a reduction below the 8 weeks currently devoted to Advanced Individual Training. Accordingly, a revised eight-week program was developed, utilizing the additional time made available by SHOCKACTION techniques for improving proficiency of the training product, and has been implemented by the U.S. Army Training Center, Armor. ATP 17-27 is now being developed to supercede the current ATP 17-201. This will result in Army-wide implementation of the program, applying training concepts and techniques reported in this report. A new tank gunnery qualification course, embodying many of the principles in this report, has been developed. It is currently being implemented, as indicated by Change Nr 3 to FM 17-79 (90mm gun) and Change Nr 2 to FM 17-80 (76mm gun). Gunner's Guide (DA TC 17-4), Driver's Guide (DA TC 17-5), and Loader's Guide (DA TC 17-6) developed in SHOCKACTION research have been published as Department of the Army Training Circulars." (Excerpt from OCRD, DA letter, 8 January 1960.)

Potential/Actual Benefits: Better training, with better training materials; the potential of saving 25% training time; and provision of a model which has application in other, selected military training programs (see Crawford, M.P. "Concepts of Training," in Gagne', R.M. (ed.) Psychological Principles in System Development, Holt, Rinehart and Winston, 1962).

Comment and Interpretation: This study was one of the first demonstrations of the potency of applying systems development thinking to training. It was also a pioneering effort in the development of pictorial training guides.

Air Defense Training

Code Name: RINGER

Dates of Study & Reference: FY64-FY65

Cox, J.A., Wood, R.O., Boren, L.M. and Thorne, H.W., "Functional and Appearance Fidelity of Training Devices for Fixed-Procedures Tasks," HumRRO Technical Report 65-4, June 1965.

Findings: There were found to be no statistically significant differences in either mean proficiency scores or average learning times. Men trained in inexpensive, low fidelity devices were as proficient as those trained with devices high in functional and appearance fidelity which cost several thousand dollars.

Field Tested: No.

Implemented: "The US Army Air Defense School has reported that application of these principles to the Air Defense Officers Basic course (C-20) resulted in better trained and qualified officers and that the school is studying further utilization of low-fidelity training devices. Low fidelity training devices appear to be appropriate for use in MOS training situations concerned with teaching the identification of parts, fixed-procedure training, and in testing programs." CONARC Pamphlet No. 70-1, 23 February 1966.

Potential/Actual Benefits: Reportedly, based on RINGER findings, the Air Defense School scrapped plans for the development of a $200,000 (est.) procedures trainer for officers.

Comment and Interpretation: This study was as much a demonstration project as it was R&D. Yet it was necessary to support the value of low (physical) fidelity trainers in procedure teaching - McClelland's view.

Electronics Maintenance

Code Name: LORAN

Dates of Study & Reference: 1963-64

Shriver, E.L., Trexler, R.C., "Application and Test of the FORECAST Concept of Electronics Maintenance on Navy LORAN Equipment," HumRRO Technical Report 65-3, May 1965.

Findings: On a 1 day test involving 98 subjects (continuing course) and including 8 malfunctions, there was a significant (.01) difference with 200% higher performance and the same training time.

Field Tested: Yes.

Implemented: "Electronics maintenance. Under Task FORECAST (23b) measures for reconstructing the troubleshooter's job, determining more efficient content, and developing more effective maintenance courses were reported. The FORECAST concept has been successfully applied to a Navy LORAN maintenance training course (23a). Concurrently the Training Command, U.S. Atlantic Fleet is testing a shipboard training course (OJT) which is a modified version of the standard course." CONARC Pamphlet No. 70-1, 23 February 1966.

Potential/Actual Benefits: "The effort described in this report demonstrates that the training concepts developed in Task FORECAST have practical applications in a variety of electronics maintenance situations. Therefore this report and the Task FORECAST material referred to in the report are recommended to those agencies having responsibility for the development of electronics maintenance programs." Cover letter to the referenced report by OCRD, DA, June 1965.

Twenty cycles of this two-week course were run after the HumRRO research team completed its work and withdrew.

Comment and Interpretation: The course development process and implementing activity proceeded quite smoothly, possibly because the operating command, COMTRALANT, arranged for funding. There was strong command support and the product was derived from earlier, extensive R&D programmatic effort for the Army -- McClelland's opinion.

Electronics Maintenance

Code Name: FORECAST I

Dates of Study & Reference: 1959-1960

Shriver, E.L., "Determining Training Requirements for Electronic System Maintenance Development and Test of a New Methods of Skill and Knowledge Analysis," HumRRO Technical Report 63, June 1960.

Findings: On a 9 day long test (N=37) including 120 malfunctions there was no significant performance difference although the experimental group received 60% less training time.

Field Tested: Yes. Shriver, E.L., Fink, C.D., Trexler, R.C., "Implementation and Checkout of the FORECAST Concept of Electronic System Repair at the U.S. Army Ordnance Guided Missile School," HumRRO Consulting Report, August 1963.

Implemented: "The US Army Missile and Munitions Center and School and the USAOC&S found research reports prepared under HumRRO Work Unit FORECAST to be useful in the support of USCONARC policy guidance for the conduct of electronics training. The US Army Missile and Munitions School used these reports (para 54g, h, and i) and a Consulting Report (para 54j) in the development of a job aids manual and instructional materials for missile electronics subjects. The USAOC&S used a Research Memorandum concerned with a simplified method for the development of programed instructional materials (para 54k) and a training manual for the implementation of FORECAST methods of task and skill analysis (para 54l) in connection with the preparation of instructional material and televised lessons." CONARC Pamphlet No. 70-1, 15 April 1963.

Potential/Actual Benefits: Savings of the type effected in the experimental study could cut most of the major items of cost by 50%.

Comment and Interpretation: The course produced in FORECAST I could not be adopted since the system made available for study was in the process of being phased out of the inventory. This fact is a major reason HumRRO was given access to so much expensive radar and laboratory equipment. However, the study did influence other electronics maintenance training programs as noted above.

Electronics Maintenance

Code Name: FORECAST II

Dates of Study & Reference: 1959

Shriver, E.L., Fink, C.D., Trexler, R.C., "Increasing Electronics Maintenance Proficiency Through Cue-Response Analysis," HumRRO Research Memorandum, October 1959. (Internal Use Only.)

Findings: On a 2 day long test (N=16) including 30 malfunctions there was a significant difference in performance, namely 40% higher performance with 50% less training time.

Field Tested: Yes. Shriver, E.L., Fink, C.D., Trexler, R.C., "Implementation and Checkout of the FORECAST Concept of Electronic System Repair at the U.S. Army Ordnance Guided Missile School," HumRRO Consulting Report, August 1963.

Implemented: "The US Army Missile and Munitions Center and School and the USAOC&S found research reports prepared under HumRRO Work Unit FORECAST to be useful in the support of USCONARC policy guidance for the conduct of electronics training. The US Army Missile and Munitions School used three reports (para 54g, h, and i) and a Consulting Report (para 54j) in the development of a job aids manual and instructional materials for missile electronics subjects. The USAOC&S used a Research Memorandum concerned with a simplified method for the development of programmed instructional materials (para 54k) and a training manual for the implementation of FORECAST methods of task and skill analysis (para 54l) in connection with the preparation of instructional material and televised lessons." CONARC Pamphlet No. 70-1, 15 April 1968.

Potential/Actual Benefits: Mockup equipment used in the study was substituted for live equipment and yet students trained on it solved 20% more of the malfunctions presented in the proficiency test that in any earlier FORECAST study. It would appear such mockup equipment has the potential of appreciably reducing reliance upon actual operating equipment during training.

Comment and Interpretation: The number of students involved in these studies were small and as a result the findings were not widely publicized and were considered largely suggestive. It was estimated costs of one experimental subject in research such as this was approximately $10,000 -- McClelland's recollection.

Electronics Maintenance

Code Name: MAINTRAIN V

Dates of Study & Reference: 1961-1963

"Rogers, J.P., Thorne, H.W., "The Development and Evaluation of an Improved Electronics Troubleshooting Manual," HumRRO Technical Report 65-1, March 1965.

Findings: An experimental manual was prepared for troubleshooting the Nike Ajax and its test equipment. An experimental group (N=8) using the manual was able to troubleshoot faster and more effectively than a control group (N=8) using standard schematic and functional diagrams and personal notes.

Field Tested: No.

Implemented: This work contributed to a subsequent study, Work Unit HAWKEYE.

Potential/Actual Benefits: An additional product was a list of desirable characteristics for troubleshooting manuals and procedures for preparing same. In FY1964 the US Army Air Defense Center, Board and Combat Developments Agency concurred in the recommendation to use techniques developed in MAINTRAIN V for preparation of troubleshooting manuals for a future air defense system.

Comment and Interpretation: In handsight it is apparent that MAINTRAIN could not have been implemented without a major change in the DA technical manual system, and such systemic changes are unlikely to be [illegible] by a [illegible] research study -- McClelland's [illegible] opinion.

Electronics Maintenance

Code Name: HAWKEYE

Dates of Study & Reference: 1966-67

_____________, "Development of a Procedure-Oriented Training Program for HAWK Radar Mechanics," HumRRO Technical Report 69-25, December 1969.

Findings: On a 1-2 day(s) test including 16-24 malfunctions the results were: lowered attrition; equal or better proficiency; no differences in rated job performance in field one year later.

Field Tested: Yes. The U.S. Army Air Defense School modified and evaluated a "first enlistment" version of the experimental program, with the special manuals to be published as DA Training Manuals and, thus, to be available for use on the job.

Implemented: "In a statement of policy guidance for the conduct of electronics training (letter, ATIT-TNG-CD, HQ USCONARC, 12 Sep 66) this headquarters included the following challenge:

> 'USCONARC is required to provision the Army's operating forces with soldiers trained in many varied electronics skills. In the foreseeable future, no significant change can be expected in the aptitude and intelligence of the input; nor to the year's service. Under current training procedures, useful service remaining after training and other non-productive activity can be as little as twelve months.' We simply can't afford a training investment that yields a one-to-one, training-time to production-time return. The ratio should be more like one-to-ten. In this training formula the available time and the average aptitude are for the moment, constants; the method of training is the only variable to manipulate.'

The guidance contained in this letter drew attention to certain HumRRO research projects that had been concerned with the development of an exploitation of new and advanced educational techniques in the electronics field. Citations were: Work Unit REPAIR (para 54c); Work Unit JOBTRAIN (para 54d); and Work Unit HAWKEYE (para 54e)." CONARC Pamphlet No. 70-1, 15 April 1968.

Implemented: con't

The U.S. Army Combat Surveillance School & Training Center (USACSS&TC) has used the concepts and techniques described in HAWKEYE research results which describe the development of a three-phased program, for structuring of airborne radar repairman (MOS 26M20) and airborne infrared repairman (MOS 26N20) courses. The school expects the use of these materials to result in effective programs of instruction while eventually allowing reductions in course length.

"In Work Unit HAWKEYE, the Functional Context Training (FCT) approach was used as a basis for developing a new program of instruction for HAWK continuous wave (CW) radar maintenance techniques. The Low Altitude Air Defense Department, USAADS, is currently using data developed from HAWKEYE research in multilevel courses and is applying it to systems engineering of enlisted and officer courses. Benefits derived from research under HAWKEYE include reduced attrition; reduction of schooling, increased proficiency of graduates - resulting in reduced costs of approximately $4,000 per student. The USAADS has recommended that additional programs of instruction for the HAWK guided missile system be converted to the multilevel approach - an approach which employs HAWKEYE training concepts and devices for entry level training." CONARC Pamphlet No. 70-1, 1 July 1971.

Potential/Actual Benefits: See above.

Comment and Interpretation: HAWKEYE, the last major HumRRO effort in electronics maintenance training R&D, was successfully implemented because the content area had been studied in earlier work, there was a good and fully cooperative relationship between USAADS and HumRRO and pitfalls in implementation had been charted and were successfully avoided.

Electronics Maintenance

Code Name: JOBTRAIN

Dates of Study & Reference: 1961-1962

Gebhard, R., "The Development and Test of a Training Program and Job Aids for Maintenance of Electronic Communication Equipment," HumRRO Technical Report 70-19, December 1970.

Findings: On a 6 day long test (N=30) including 18 malfunctions there was no significant performance difference although the experimental group received 50% less training time.

Field Tested: No. One planned by the Army including a seven months field follow-up was subsequently dropped.

Implemented: "In the statement of policy guidance for the conduct of electronics training (letter, ATIT-TNG-CD, HQ USCONARC, 12 Sep 66) this headquarters included the following challenge:

> 'USCONARC is required to provision the Army's operating forces with soldiers trained in many varied electronics skills. If the foreseeable future, no significant change can be expected in the aptitude and intelligence of the input; nor to the fact that most will be committed for only two years' service. Under current training procedures, useful service remaining after training and other non-productive activity can be as little as twelve months. We simply can't afford a training investment that yields a one-to-one, training time to production-time return. The ratio should be more like one-to-ten. In this training formula the available time and the average aptitude are for the moment, constants: the method of training is the only variable to manipulate.'

The guidance contained in this letter drew attention to certain HumRRO research projects that had been concerned with the development of an exploitation of new and advanced educational techniques in the electronics field. Citations were: Work Unit REPAIR (para 54c); Work Unit JOBTRAIN (para 54d); and Work Unit HAWKEYE (para 54e)." CONARC Pamphlet No. 70-1, 15 April 1968.

JOBTRAIN

Implemented: con't — Full utilization of course could not be secured because authorization could not be obtained to change technical manuals in a way called for by JOBTRAIN procedures. Electronics training in the JOBTRAIN manner was not acceptable to key personnel in Hq USCONARC and Southeast Signal School at the time of completion of study. Informal reports suggest that some aspects of JOBTRAIN have been used.

Potential/Actual Benefits: Were the military training manual system less unyielding, marked savings could be effected through the reduction of the training time required to achieve acceptable trainee proficiency.

Comment and Interpretation: HumRRO experimented with several electronics maintenance manual philosophies and formats, as in FORECAST, MAINTRAIN, HAWKEYE and JOBTRAIN. It appeared that the architecture and engineering of the gear varied as considerably as did the researchers' concepts. Thus a single organizational posture was never achieved.

Electronics Maintenance

Code Name: MOSIAC, Studies on Organization and Operation of Electronics Maintenance Units

Dates of Study & Reference: 1964-1967

Shriver, E.L., Trexler, R.C., Hibbits, F.L., Lodge, R., Gillson, P. and Pressgrove, A., "A Description of Work Flow in Support of a HAWK Missile System," Research Memorandum, November 1964.

Scope: "a. Objective of research. To develop and test a method for raising the effectiveness and efficiency of missile units through an analysis and restructuring of the electronics maintenance process.

b. Background and summary. The generally accepted concept for repair of equipment is to accomplish as much as possible at the lowest possible echelon. Application of this concept is limited by factors of cost, mobility, and personnel capabilities. A balance must be achieved between these factors and speed in returning equipment to operable condition. The factors affecting this balance change with advances in the state of the art (e.g., electronic parts become lighter, improved test equipment becomes available, and more effective training programs are developed). No one Army command or agency, other than the Chief of Staff, has cognizance over all the factors entering into the balance - personnel, logistics, missile command, combat developments, operations, and so forth. The eight Army commands and agencies having responsibility for some aspect of the problem are compartmentalized to facilitate command action rather than organized for contemplation of change.

The MOSAIC studies were made by observation, literature search, computer simulation, and systematic analysis. On the basis of these studies, in MOSAIC II a single plan has been developed for testing with one Hawk missile unit. The plan is based on cost factors as well as on estimates of human capabilities (after training). Ways of measuring unit effectiveness in meaningful terms (percent kills) have been developed for use in comparing a MOSIAC experimental unit with conventional units.

c. FY 1967 projection. A Hawk missile battery, including its proportion of Defense Support Unit (DSU) support, is to be operated as an experimental unit. This unit

would operate with a new organization of job duties and operational rules; its inputs (logistics, training, technical manuals, etc.) will be changed or made subject to change for experimental work. The internal organization and operations of the unit, as well as input conditions, will be modified on the basis of plans developed in MOSAIC I. The effectiveness and cost of the unit will be measured and compared to conventional units." Excerpt from FY67 Army Work Program.

Field Tested: No. For over a year briefings seeking endorsement and authorization of troop support were given at major headquarters and DA staff agencies. They culminated in a decision by the Chief of Staff (thru DCSPER) not to proceed to the field test.

Implemented: No.

Potential/Actual Benefits: A HumRRO cost study suggested savings up to 10 million dollars a year might be realized over the remainder of the life of the HAWK system if the MOSAIC concept proved successful and was adopted.

Comment and Interpretation: The final Army decision indicated that the study would require unanticipated external re-direction of the careers of 100+ men thus violating the Army "choice not chance" recruiting policy. In retrospect it would appear that the MOSAIC proposal was too radical, too large in scope, and too late in the life of the HAWK system. Further, HumRRO apparently didn't know how to effect change of this magnitude. McClelland's personal view.

Infantry Training

Code Name: Simulation in Live Firing

Dates of Study & Reference: 1971-1972

Dees, J.W., Magner, G.J. and McCluskey, M.R., "An Experimental Review of Basic Combat Rifle Marksmanship: MARKSMAN, Phase 1," HumRRO Technical Report 71-4, March 1971.

Findings: This report describes a series of 21 experiments addressing both "what" should be taught and "how" it should be taught. A number of conclusions were reached concerning such matters as the use of automatic fire, aimed fire vs. pointing fire including Quick Fire, night firing techniques, firing positions, carry positions, aiming points, night sights, multiple targets, area targets, surprise targets, sight calibration, and other issues. Subsequent to this set of experiments two studies were undertaken involving varying combinations of live firing and Laser device training, involving both experienced and naive firers. There were no significant differences in record firing scores among the groups.

Field Tested: The studies themselves were essentially field tests.

Implemented: Acquisition of Laser training devices has been under consideration for some months. Concerns about their lack of physical fidelity to live firing (noise, recoil) are believed to have been raised in staffing actions. The contribution of live firing exercises to weapons proficiency for the M60A1 tank and 105 mm Howitzer is the subject of a current ARI sponsored study.

Potential/Actual Benefits: In FY72 an Infantry School cost comparison study of the M16 rifle and the Laser training device (60% of the field fire practical exercises replaced by Laser firing) indicated a potential annual savings of $2,500,000 or over $8.00 per firer, it was learned. McClelland's recollection.

Comment and Interpretation: The MARKSMAN study, a very closely coordinated joint Infantry School-HumRRO effort, was implemented. The Army's basic combat rifle marksmanship training was markedly changed in directions suggested by the experimental findings. It is the subsequent Laser studies which bear on the potential for savings through simulation.

APPENDIX 4-7

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR PERSONNEL
WASHINGTON, D.C. 20310

DAPE-PBR

19 FEB 1975

MEMORANDUM FOR: LIEUTENANT COLONEL HENRY L. TAYLOR, EXECUTIVE SECRETARY, DSB TASK FORCE ON TRAINING TECHNOLOGY

SUBJECT: DSB Task Force on Training Technology

1. This is in reply to your Memorandum, 23 Jan 1975, subject as above.

2. Army responses to selected supplemental questions forwarded by your Memorandum of 23 Jan 1975, subject as above, are attached. The question numbers and responding inclosures are as follows:

(Meeting 25-26 Nov 1974)

Army Question #	Inclosure #
1	7
2	2
3	3
4	4
5	5
6	1 (Tabs B-F)
9	6
10	7

(Meeting 16-18 Dec 1974)

All Services Question #	
1	(Distributed at Task Force meeting 18 Feb 75)
2	8

Army Question #	
1-3	(Input furnished directly to LTC Taylor by letter from Dep. Proj. Mgr. for Training Devices, 23 Dec 74, Subj: Information for Defense Science Board)

19 FEB 1975

DAPE-PBR
SUBJECT: DSB Task Force on Training Technology

Army Question # (Cont'd.)	Inclosure # (Cont'd.)
4	1 (TAB A)
5	9
6	1
7	9
8	10
12, 13	11

3. Additional responses will be furnished as received.

J. L. Barber

11 Incl
as

J. L. BARBER
Army Principal Point-of-Contact
for DSB Task Force on Training
Technology

Response to Defense Science Board Request for Information

P. 2 [illegible] SERVICES Q. 1

Copy of a response to the same question directed by Dr. Allensisi to Col. Roeth and Dr. Tholmer, Commander and Technical Director of [illegible] respectively, at the 16 December meeting of the Board is attached.

Q. 2 Regarding cost-effectiveness studies.

The initial effort to develop methodology for cost-effectiveness studies is an R&D activity. The development of good criteria of training effectiveness is a prerequisite for both research dealing with products necessary for training purposes and for control for part of the cost-effectiveness studies. The training criteria do not necessarily suffice for the purpose of cost-effectiveness studies. Other indices are needed, for example, cost data, including:

cost of training under method A vs. method B
cost of individuals being kept for "t" period of time
cost of attrition
cost of maintaining the system
cost of equipment required.

Frequently, these additional items of information are costly to come by and need to be analyzed in a studies (6.5) mode.

Additional considerations, in cost-effectiveness studies, include quality of student input, which may affect the cost effectiveness of training programs, and the type and level of subsequent training, such as OJT, may also bear on conclusions about cost effectiveness. The rules or procedures for obtaining cost figures, for determining appropriate criteria of effectiveness, and for relating cost and effectiveness need to be determined through R&D efforts.

The conduct of cost-effectiveness studies is a 6.5 studies activity.

Incl. 8

Appendix 5-1

SCOPE OF OFFICER ACQUISITION TRAINING AND PROFESSIONAL DEVELOPMENT EDUCATION PROGRAMS

As stated in the Military Manpower Training Report for FY 1976, "Officer Acquisition Training consists of training programs leading to a commission in one of the military services. The purpose of these programs is to fulfill the need for qualified junior officers as entrants into the career force and to meet requirements for non-career junior officer structure. Officer Acquisition Training programs produce officers for both the active force and the reserve components."

Training loads for Officer Acquisition Training (OAT) for FY 1973-1978 are provided in the table on the next page.

OAT costs for FY 1973-197T are given below:

Officer Acquisition Training Costs, FY 1973-197T
($ Millions)

	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T
Army	205.7 (53.6)	105.1 (26.8)	114.1 (28.7)	112.1 (24.9)	27.4 (6.9)
Navy	140.6 (51.7)	109.0 (50.4)	120.7 (52.4)	108.3 (49.5)	27.7 (12.6)
USMC	12.2 (4.7)	14.8 (5.5)	17.4 (6.8)	17.7 (7.4)	6.3 (3.3)
Air Force	154.9 (47.5)	112.5 (38.6)	115.0 (41.3)	119.6 (40.8)	30.9 (10.7)
DoD	513.4 (157.5)	341.4 (121.3)	367.2 (129.2)	357.7 (122.6)	92.3 (33.5)

Note: Figures in parentheses show student pay and allowances included in the figures immediately above.

Total Training Loads, Officer Acquisition Training, FY 1973-1978

Service Component	FY 1973	FY 1974	FY 1975	FY 1976	FY 197T	FY 1977	FY 1978
Army							
Active	5780	5356	5260	4838	4852	4686	4634
Reserve	157	130	137	131	101	131	131
Natl. Guard	-	-	2	2	2	2	2
Navy							
Active	7169	6910	6731	6488	6492	6583	6734
Reserve	179	108	126	126	84	84	60
USMC							
Active	398	414	474	485	512	501	501
Reserve	271	285	333	347	936	366	366
Air Force							
Active	5842	5784	5873	5667	6320	5686	5641
Reserve	25	20	11	12	16	12	12
Natl. Guard	1	-	3	1	-	1	1
DoD							
Active	19189	18464	18338	17478	18176	17456	17510
Res/Gd Total	633	543	612	619	1139	596	572
DoD Total	19822	19007	18950	18097	19315	18052	18082

Although a separate area of training, Professional Development Education (PDE) is closely related to Officer Acquisition Training. As defined in the MMTR for FY 76, "The purpose of Professional Development Education is to provide training and education to prepare military personnel to perform the increasingly complex tasks which will become their responsibilities as they progress in their military careers - - - . Professional Development Education is concerned with broad professional development goals in such subjects as military science, engineering, medicine, and management. PDE is conducted at both military and civilian institutions - - -. Some enlisted personnel participate in courses included in this category - - -. However, most of the programs in this category are for the professional development of officers."

PDE training loads for FY 1973-1978 are provided on the next page.

Total Professional Development Education Loads, FY 1973-1978

Service Component	FY 1973	FY 1974	FY 1975	FY 1976	FY 19T	FY 1977	FY 1978
Army							
Active	5849	5868	5153	4544	3986	4456	4456
Reserve	87	103	107	123	123	123	123
Natl. Guard	58	69	74	72	73	73	73
Navy							
Active	5112	5723	5002	3813	3113	2915	2862
Reserve	12	24	26	33	37	23	23
USMC							
Active	1874	1079	974	834	484	739	741
Reserve	52	16	18	18	56	18	18
Air Force							
Active	5596	4889	5018	4979	5120	4943	4873
Reserve	68	49	71	58	72	58	58
Natl. Guard	92	39	40	39	32	39	39
DoD							
Active	18431	17559	16147	14170	12703	13083	12932
Gd/Res Total	369	300	336	343	393	334	334
DoD Total	18800	17859	16483	14513	13096	13417	13266

Costs for Professional Development Education for FY 1973-197T are presented in the table below:

Professional Development Ecucation Costs, FY 1973-197T
($ Millions)

	FY 1973	FY 1974	FY 1975	FY 1976	FY 196T
Army	175.6 (96.6)	152.9 (92.7)	144.4 (79.1)	144.0 (79.0)	45.9 (28.8)
Navy	120.9 (69.5)	118.8 (74.5)	123.4 (71.6)	104.1 (58.5)	26.9 (14.6)
USMC	57.2 (31.1)	36.9 (17.2)	30.5 (16.5)	28.0 (15.2)	6.9 (3.2)
Air Force	132.6 (79.7)	144.0 (94.4)	161.8 (105.0)	166.8 (108.3)	44.2 (28.7)
DoD	486.3 (276.9)	452.6 (278.8)	460.1 (272.2)	442.9 (261.0)	123.9 (75.3)

DESCRIPTION OF OFFICER ACQUISITION TRAINING AND PROFESSIONAL DEVELOPMENT EDUCATION PROGRAMS

OFFICER ACQUISITION TRAINING

Each of the services acquire new officers through a mix of the various programs of Officer Acquisition Training. The six categories of OAT are: Service Academies; Reserve Officer Training Corps (ROTC); Officer Candidate School (OCS); Off-Campus Commissioning Programs (the Marine's Platoon Leaders Class and the Navy's Reserve Officer Candidate and Aviation Reserve Officer Candidate programs); Enlisted Commissioning Programs (Navy Enlisted Scientific Education Program and the Air Force's Airman Education and Commissioning Program); and the Health Professionals Acquisition Programs.

Service Academies

The purpose of the Service Academies (United States Military Academy, United States Naval Academy and United States Air Force Academy) is to meet the long-range requirement for career military officers. Each Academy provides a program of academic studies leading to a bachelor of science degree with a curriculum specifically designed to prepare the cadets and midshipmen for service as professional officers. The programs include the sciences, the humanities, and military and physical training, and form the basis for further professional development or, when required, graduate education. Training load data for the Service Academies for FY 1974 through FY 1978 are shown in the following table:

Training Inputs, Outputs, Loads, Service Academies, FY 1974-1978

Year	Army			Navy			Air Force			DoD Total		
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load
FY 1974	1376	833	3881	1425	874	4171	1409	806	3890	4210	2513	11942
FY 1975	1450	875	4027	2601	834	4171	1576	758	4220	5627	2467	12418
FY 1976	1425	875	4130	1388	815	4150	1647	935	4138	4460	2625	12418
FY 197T	1400	0	4370	285	0	4180	85	0	4552	1770	0	13102
FY 1977	-	-	4225	-	-	4200	-	-	3972	-	-	12397
FY 1978	-	-	4225	-	-	4200	-	-	3965	-	-	12390

Note: The varying input figures for FY 197T are the result of different reporting times (before or after July 1, 1976) for members of the entering class.

Each of the Military Departments sponsors an Academy preparatory school which has the mission of providing intensive instruction and guidance, in courses of instruction approximating one academic year, to selected enlisted personnel in preparation for entry to the service academies. The participants also include students competing for appointments by the Secretaries of the Military Departments and students from other sources. The Naval Academy Preparatory School provides instruction to Marine Corps personnel as well as candidates for the Navy Enlisted Scientific Education Program.

Training Inputs, Output, Loads, Academy Preparatory Schools, FY 1974-1978

Service/ Component	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army														
Active	173	96	126	188	115	142	170	100	127	170	0	115	127	127
Reserve	148	133	130	153	140	135	150	130	129	150	0	100	129	129
Navy														
Active	511	381	208	511	381	208	511	381	208	300	100	162	215	215
USMC														
Active	42	24	25	28	18	17	50	30	30	50	0	76	30	30
Air Force														
Active	243	138	140	258	150	140	260	150	140	250	0	252	140	140
DoD														
Active	969	639	499	985	664	507	991	661	505	770	100	605	512	512
Reserve	148	133	130	153	140	135	150	130	129	150	0	100	129	129
DoD Total	1117	772	629	1138	804	642	1141	791	634	920	100	705	641	641

ROTC Programs

ROTC is a long lead-time program which is the single largest source of officers for the Armed Forces. Like the Service Academies, ROTC is used to provide a relatively constant input of officers for active duty, but ROTC also provides non-career officers as well as career officers. The program is currently conducted at 379 civilian colleges and universities throughout the nation. The Army, Navy, and Air Force each sponsor an ROTC program; the Marine Corps commissions a small number of Navy ROTC graduates.

Even though ROTC is the largest source for officers, ROTC data is not included in Officer Acquisition training loads because the students are not in an active military status. ROTC load data is presented in the table on the following page.

Training Inputs, Output, Loads, ROTC Programs, FY 1973-1978

Service	FY 1974 Input	FY 1974 Output	FY 1974 Load*	FY 1975 Input	FY 1975 Output	FY 1975 Load*	FY 1976 Input	FY 1976 Output	FY 1976 Load*	FY 197T Input	FY 197T Output	FY 197T Load*	FY 1977 Load*	FY 1978 Load*
Army							20484	5095	41221					
Navy	2654	1295	7221	3685	1272	8100	2815	1480	8100	3075	0	8820	8100	8100
Air Force							8695	3575	18209					
DoD							31994	10150	67530					

* Load figures actually indicate enrollees in ROTC Programs

Course Lengths, Officer Candidate Schools

Service / Course	Course Length (Weeks)
Army	
OCS (Male students)	14
WAC Officer Orientation Course	11
Navy	
OCS (Male and Female students)	19
Aviation OCS	16
Marine Corps	
OCS (Male students)	12
Women's OCS	8
Warrant Officer Candidate Schools	$6\frac{1}{2}$
Air Force	
OTS (Male and Female students)	12

Load data for OCS programs in FY 1974-1978 are shown in the table on the following page.

Training Inputs, Outputs, Loads, Officer Candidate Schools, FY 1974-1978

Service/ Component	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Army														
Active	590	491	128	850	693	191	1298	968	282	360	307	282	282	282
Reserve	2	2	0	8	8	2	8	8	2	2	2	1	2	2
Natl.Guard	2	2	0	9	9	2	9	9	2	3	3	2	2	2
Navy														
Active	1799	1509	531	1735	1730	505	1315	1078	321	377	351	341	355	506
USMC														
Active	1235	898	219	1459	1016	256	1398	957	235	433	332	324	241	241
Reserve	4	4	1	10	9	2	10	9	2	3	2	4	2	2
Air Force														
Active	2670	2279	684	1994	1755	441	1439	1266	318	656	577	580	503	465
Reserve	62	47	20	48	42	11	52	46	12	19	17	16	12	12
Natl.Guard	0	0	0	15	13	3	5	4	1	1	1	0	1	1
DoD														
Active	6294	5177	1562	6038	5194	1393	5450	4269	1156	1826	1567	1527	1381	1494
Gd/Res Total	70	55	21	90	81	20	84	76	19	28	25	23	19	19
DoD Total	6364	5232	1583	6128	5275	1413	5534	4345	1175	1854	1592	1550	1400	1513

Army Officer Candidate School for men is conducted at Fort Benning, Georgia, and for women at Fort McClellan, Alabama. Upon completion of a 14 week Branch Immaterial Officer Candidate Course, male officer candidates attend their Branch Officer Basic Course. Graduates of OCS are commissioned as second lieutenants in the Army, Army National Guard or Army Reserve.

The Navy OCS programs consist of 19 weeks of training at the Naval Education at Training Center, Newport, Rhode Island. Included in the curriculum are courses in Naval orientation, general military training, communications, leadership techniques, seapower, navigation, seamanship, management, and operations security. Classes are taught by the lecture/demonstration method augmented by hands-on and at sea training.

The Naval Aviation Officer Candidate School is an eleven week program conducted at the Naval Air Station, Pensacola, Florida. In addition to the military training and academic subjects taught at the regular OCS, the course content also includes aerodynamics, aviation psychology, aviation engines, remedial mathematics/physics, and survival training.

Included in the curriculum of the Marine Corps OCS program are physical training, small unit tactics, leadership, weapons, and general military subjects. The program is conducted at Quantico, Virginia, and course length is 83 days. Another program, the Warrant Officer Candidate Course, is a precommissioning program for enlisted Marines. Curriculum is the same as OCS, but the course length is 54 days. Graduates of the program are appointed to the grade of warrant officer, W-1.

OFF-CAMPUS COMMISSIONING PROGRAMS

The Officer Acquisition Training programs in which college students participate but which are conducted off the college campus are the Navy's Reserve Officer Candidate (ROC) and Aviation Reserve Officer Candidate (AVROC) programs, and the Marine Corps Platoon Leaders Class (PLC). These programs provide for enlistments as a Naval or Marine Corps Reservist while the student is still an undergraduate and require participation in summer military training.

Students participating in these programs attend either one or two summer training sessions, depending upon when, during their college career, they were enrolled. The objectives of the programs are to indoctrinate, motivate, and train the enrollees by providing instruction in basic military subjects, leadership, and physical training. In addition, students enrolled in the Aviation Reserve Officer Candidate program receive flight indoctrination and training. ROC and AVROC students attend Navy Officer Candidate courses prior to receiving their commissions. PLC students are commissioned when their college degrees are conferred; the newly commissioned officers then attend the Marine Corps Officer Basic Course.

In conformance with the nature of these programs, the training loads in the table on the following page are based only on the time spent in summer training. Loads, consequently, are low as compared to inputs and outputs.

Training Inputs, Output, Loads, Off-Campus Commissioning Programs FY 1974-1978

Component/ Program	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Naval Reserve														
ROC	173	190	58	260	153	66	260	153	66	0	0	24	24	24
AVROC	376	271	50	450	340	60	450	340	60	300	225	60	60	60
USMC Reserve														
PLC	2487	1791	284	2999	2001	331	3175	2614	345	1022	2611	932	364	364
DoD Total	3036	2252	392	3709	2494	457	3885	3107	471	1322	2836	1016	448	448

<u>Enlisted Commissioning Programs</u>

The Air Force, Navy, and Marine Corps each have enlisted commissioning programs in addition to Officer Candidate Schools. The purposes of these programs are: (1) to provide a source of officers in specific skills with an expected high rate of retention; (2) to provide an avenue whereby enlisted personnel with proven qualifications can augment the commissioned ranks, and (3) to provide a measure of motivation to enlisted personnel. In all of the enlisted commissioning programs, participants attend Officer Candidate School before they are commissioned.

The Navy Enlisted Scientific Education Program (NESEP) provides an opportunity for outstanding Navy petty officers to attain a baccalaureate degree at 23 universities in the engineering/hard science area and a commission in the U. S. Navy or Marine Corps. The primary objective of NESEP is to provide the Navy a source of career oriented unrestricted line officers who are highly qualified in specific engineering/scientific disciplines. Academic areas of study authorized for NESEP students include eight engineering, four science and two mathematics degree programs. Additionally, each NESEP student must complete certain Navy Specified Courses which are designed to strengthen his value to the Navy.

Similar to NESEP, the Marine Corps offers a degree program in the liberal arts in the Marine Enlisted Commissioning Education Program. The program is offered at any one of the 23 participating NROTC universities. Students are enrolled for the minimum amount of continuous time required to obtain a baccalaureate degree, with four years as the maximum time allowed. Marines selected for this program must complete the 83 days of precommissioning training prescribed for the Officer Candidate Course.

The Airmen Education and Commissioning Program (AECP) is monitored by the Air Force Institute of Technology located at Wright-Patterson AFB, Ohio. Students in AECP major in engineering, science, mathematics, or management at colleges and universities throughout the United States. Upon completion of the program, students are assigned to Officer Training School to complete commissioning requirements.

The table on the following page displays load data for these programs in FY 1974-1978. All participants are members of the active forces.

Training Inputs, Output, Loads, Enlisted Commissioning Programs, FY 1974-1978

Service	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Navy	390	275	1168	270	280	1014	300	270	1044	315	50	1044	1048	1048
USMC	107	45	170	98	49	201	115	93	220	83	50	112	230	230
Air Force	432	283	635	158	305	627	400	311	640	95	95	640	640	640
DoD Total	929	603	1973	526	634	1842	815	674	1904	493	195	1796	1918	1918

Health Professions Scholarships

This subcategory may be conveniently divided into two parts, the Armed Forces Health Professionals Scholarship Programs and "other health professionals acquisition programs". The Health Professionals Scholarship program enables eligible persons to attend accredited educational institutions which provide training in those health professions designated by the Assistant Secretary of Defense (Health and Environment). At present these programs cover medicine (allopathic and osteopathic), denistry, veterinary medicine, optometry, podiatry and psychology at the PhD level. All tuition, fees, books and other educational expenses are paid by the service. Upon graduation, participants must serve obligated tours of duty, the length of which depends on the length of their participation in the program.

Participants are commissioned in grade O-1 in the Reserve of their parent service, but, except for a short period of annual active duty, are not in active status. They are, therefore, not included within the training loads of their services.

The program is authorized a total of 5,000 scholarships of which presently 1850 are allocated to the Army, 1575 to the Navy, and 1575 to the Air Force. Service data for FY 1974-1978 are shown in the table on the following page.

Inputs, Output, Loads, Armed Forces Health Professionals Scholarship Programs, FY 1974-1978

Service	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load*	Input	Output	Load*	Input	Output	Load*	Input	Output	Load*	Load*	Load*
Army	1013	360	1108	538	552	1375	536	556	1375	356	0	344	1375	1375
Navy	861	340	1530	389	487	1575	477	464	1575	470	0	1575	1575	1575
Air Force	852	164	1118	412	404	1507	404	397	1507	24	21	1452	1507	1507
DoD Total	2726	864	3756	1339	1443	4457	1417	1417	4457	850	21	3371	4457	4457

* Load figures are actually Scholarship Authorized

"Other health professionals acquisition programs" include a variety of programs with the purpose of recruiting required health professionals into the services through tuition assistance or other aid. Among the included programs are programs for medical, dentistry, nursing, and other students in the health professions. Some programs offer assistance for full courses of professional training, whereas others are offered only to students in their final year of study. Some included programs support health professions training for active duty service members, intended to produce high-retention health professionals. Participants in all programs incur an active duty obligation commensurate with the educational support received.

Load data for FY 1974-1978 are shown in the table on the following page.

Training Inputs, Output, Loads, Other Health Professionals Acquisition Programs, FY 1974-1978

Service	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army	578	809	1221	423	713	900	10	377	299	0	0	85	52	[illegible]
Navy	380	421	832	343	330	833	351	327	765	278	12	765	765	765
Air Force	215	173	435	109	141	445	114	178	431	23	13	296	431	431
DoD Total	1173	1403	2488	875	1184	2178	475	882	1495	301	25	1146	1248	1196

Professional Development Education

As previously stated, Professional Development Education (PDE) provide training and education to prepare military personnel, primarily officers, to perform the tasks which will become their responsibilities as they progress in their military careers. PDE is divided into eight categories: Basic Officers Professional Schools; Intermediate Service Schools; Senior Service Colleges; Enlisted Leadership Training; Graduate Education for Validated Billets; Other Degree-Completion Programs; Other Full-Time Education (Non-Degree Programs); and Health Professionals Education.

Basic Officers Professional Schools

The Marine Corps and Air Force conduct basic officer courses for officers with some experience in operational units. The courses are Service-wide in scope and are, therefore, considered part of PDE. The Army and Navy conducts courses at a similar level, but the courses are considered to be specialized skill training because they are oriented toward a specific skill or toward somewhat broader skills within a specific part of the service.

The Air Force Squadron Officer School is an eleven week course designed to prepare selected captains and lieutenants, after completion of some active service experience, for command and staff duties appropriate to their grades. Course content includes instruction in communicative skills, leadership and management, the environment of military force employment, and military capabilities and employment concepts.

The Marine Corps Amphibious Warfare Course is designed to prepare officers in the grades of captain and major for duties in battalion or squadron command or on regimental-level staffs. The course length is 39 weeks and is taught at Quantico, Virginia. Course content includes organization and equipment, command and management, amphibious operations, and weapons.

The training load data for Basic Officers Professional Schools are displayed in the table on the following page.

Training Inputs, Output, Loads, Basic Officers Professional Schools, FY 1974-1978

Service/ Component	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
USMC														
Active	176	174	131	179	179	133	171	171	127	180	0	72	135	135
Reserve	175	175	7	175	175	7	175	175	7	175	175	28	7	7
Air Force														
Active	2265	3009	558	3040	3040	643	3040	3040	643	777	777	648	643	643
Reserve	4	6	1	6	6	1	6	6	1	1	1	0	1	1
Natl.Guard	19	25	5	21	21	4	21	21	4	6	6	4	4	4
DoD														
Active	2441	3183	689	3219	3219	776	3211	3211	770	957	957	720	778	778
Res/Gd Tot	198	206	13	202	202	12	202	202	12	182	182	32	12	12
DoD Total	2639	3389	702	3421	3421	788	3413	3413	782	1139	1139	752	790	790

Intermediate Service Schools

Each of the services maintains a Command and Staff College. In addition, the Navy operates the Armed Forces Staff College, a joint institution with students from all Services. While there are differences in approach and curriculum based on the requirements of the parent service, each of the courses is designed to prepare officers for command and staff duties at all echelons of their parent services and in joint or allied commands. A relatively small number of officers from each service attends one of the Command and Staff Colleges of the other services; a few attend allied schools at the same level. Attendance at the Intermediate Service Schools is on a selective basis, and normally officers do not attend more than one of these schools.

Another school in the Intermediate Service Schools category is the Defense Systems Management School at Fort Belvoir, Virginia. This is a joint school which conducts a primary 20-week course in management concepts and methods with the major purpose of preparing selected military officers and DoD civilian personnel for assignments in program or project management.

The following table lists the Command and Staff Colleges and their respective course lengths. In addition to the principal courses, the service colleges individually conduct various courses for reserve component officers and a variety of nonresident courses.

Intermediate Service Schools

Schools	Location	Course Length (Weeks)
Armed Forces Staff College	Norfolk, VA	22
Army Command and General Staff College	Fort Leavenworth, KA	38
College of Naval Command and Staff	Newport, RI	40
Marine Corps Command and Staff College	Quantico, VA	42
Air Command and Staff College	Montgomery, AL	43
Defense Systems Management School	Fort Belvoir, VA	20

Load data for Intermediate Service Schools for FY 1974-1978 is shown in the table on the following page.

TRAINING INPUTS, OUTPUT, LOADS, INTERMEDIATE SERVICE SCHOOLS, FY 1974-1978

Service/ Component	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army														
Active	1816	1816	987	1867	1867	906	1905	1905	908	1791	1791	908	908	908
Reserve	1823	1823	87	1729	1729	88	2129	2129	104	2129	2129	104	104	104
Natl.Guard	840	840	55	759	759	59	838	838	55	838	838	56	56	56
Navy														
Active	301	296	221	294	298	220	362	358	220	220	64	205	235	235
USMC														
Active	177	178	131	181	181	133	182	182	134	160	22	84	134	134
Reserve	170	170	7	170	170	7	170	170	7	165	165	24	7	7
Air Force														
Active	686	686	554	680	680	549	686	686	555	604	0	408	555	555
Reserve	125	124	14	132	132	14	132	132	14	12	0	8	14	14
Natl.Guard	132	132	14	132	132	14	132	132	14	12	0	8	14	14
DoD														
Active	2980	2976	1893	3022	3026	1808	3135	3131	1817	2775	1877	1605	1832	1832
Gd/Res Total	3090	3089	177	2922	2922	182	3401	3401	194	3156	3132	200	195	195
DoD Total	6070	6065	2070	5944	5948	1990	6536	6532	2011	5931	5009	1805	2027	2027

Senior Service Colleges

Each of the Military Departments maintains a Senior Service College, or "War College". In addition, there are two joint Senior Service Colleges, the National War College and the Industrial College of the Armed Forces, attended by students from all four services. Senior Service College attendance is on a highly selective basis; students are chosen by service selection boards from among the most promising officers in the lieutenant colonel/colonel, commander/captain grades. The length of the principal course at each of the Senior Service Colleges is ten months.

The common purpose of the Senior Service Colleges is to prepare students for senior command and staff positions at the highest levels in the national security establishment and the allied command structure. The unifying focus is the study of national goals, The service colleges, while concentrating on the employment of that service in the defense mission, also include the study of the employment of the forces of other services. All of the colleges integrate the study of economic, scientific, political, sociological, and other factors into the consideration of national security problems.

The U. S. Army War College offers a ten month resident course once a year at Carlisle Barracks, Pennsylvania. The missions of the College are to offer a course of study that will prepare its graduates for senior command and staff positions within the Army and throughout the defense establishment, and that will promote an understanding of the art and science of land warfare; to conduct strategic studies on the nature and use of the U. S. Army during peace and war, to formulate strategic concepts in support of U.S. national objectives; and to operate an element of HQDA Command and Control System.

The Naval War College at Newport, Rhode Island has similar missions as the other war colleges, but oriented towards naval operations. The curriculum is designed to educate officers in the broad aspects of problems facing the decision maker rather than training for technical jobs. It consists of three courses based on the areas of strategy and policy, defense management (defense economics and decision making) and naval operations.

The Air War College is located at Maxwell AFB, Alabama. The course content includes a study of the national and international context of military issues, the management of human and material resources, an examination of military capabilities and strategy, and a study of U.S. national security issues.

The Industrial College, in its approach to national security problems, emphasizes the use and management of national resources.

Load data for FY 1974-1978 for the Senior Service College are provided in the table on the following page.

TRAINING INPUTS, OUTPUT, LOADS, SENIOR SERVICE COLLEGES, FY 1974-1978

Service/	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
Component	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army														
Active	432	432	270	429	429	273	489	489	275	489	184	275	275	275
Reserve	83	83	11	201	201	12	159	159	12	159	111	12	12	12
Natl.Guard	211	211	8	92	92	8	104	104	9	104	60	9	9	9
Navy														
Active	180	181	161	183	182	163	184	183	165	182	3	103	170	170
USMC														
Active	62	60	54	60	62	54	52	61	44	51	20	24	43	45
Reserve	29	29	1	29	29	1	29	29	1	0	0	0	1	1
Air Force														
Active	387	386	352	349	349	318	356	356	325	353	0	268	325	325
Reserve	66	66	7	66	66	7	76	76	7	6	0	4	7	7
Natl.Guard	30	30	6	32	32	6	42	42	6	6	0	4	6	6
DoD														
Active	1061	1059	837	1021	1022	808	1081	1089	809	1075	207	670	813	813
Gd/Res Total	419	419	33	420	420	34	410	410	35	275	171	29	35	35
DoD Total	1480	1478	870	1441	1442	842	1491	1499	844	1350	378	699	848	848

Enlisted Leadership Training

The courses included in this category are intended to provide senior enlisted personnel the skills and knowledge needed to assume the responsibilities of the highest non-commissioned officer grades. These courses are the culmination of formal enlisted training and are, for enlisted personnel, analogous to the officer courses discussed in the preceding sections. In addition to such subjects as methods of leadership, human relations, discipline and training, and the administration and employment of military organizations, the senior non-commissioned officer, in these higher-level schools, is given a broader perspective of the role and functions of his or her service.

Schools, locations and course lengths are shown below:

School	Location	Course Length (Weeks)
Army: Sergeants Major Academy	Fort Bliss, TX	22
Marine Corps: Staff NCO Academy	Quantico, VA	6
Air Force: Senior NCO Academy	Gunter AFB, AL	9

Training loads for Enlisted Leadership Training for FY 1974-1978 are provided in the table on the following page.

TRAINING INPUTS, OUTPUT, LOADS, ENLISTED LEADERSHIP TRAINING, FY 1974-1978

Service Component	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Army														
Active	374	374	172	368	368	162	403	403	163	219	35	163	163	163
Reserve	11	11	5	16	16	7	23	23	7	15	7	7	7	7
Natl.Guard	14	14	6	16	16	7	24	24	8	16	8	8	8	8
USMC														
Active	727	654	80	554	508	63	554	510	63	110	2	20	63	63
Reserve	2	2	1	25	25	3	25	25	3	10	5	4	3	3
Air Force														
Active	1153	1149	199	1153	1153	200	1153	1153	200	231	231	160	200	200
Reserve	16	13	2	15	15	2	15	15	2	3	3	4	2	2
Natl.Guard	31	32	6	32	32	6	32	32	6	6	6	4	6	6
DoD														
Active	2254	2177	451	2075	2029	425	2110	2066	426	560	268	343	426	426
Gd/Res Total	74	72	20	104	104	25	119	119	26	50	29	27	26	26
DoD Total	2328	2249	471	2179	2133	450	2229	2185	452	610	297	370	452	452

The Army Senior ROTC program is conducted at four-year civilian educational institutions and military junior colleges. At present, 291 civilian colleges and universities provide this program. Upon graduation and completion of the ROTC program, students are commissioned into the Regular Army, National Guard, or Army Reserve.

Naval ROTC is conducted at 58 colleges and universities throughout the country. Although the program is four years, students who have completed two years of college work may enter the NROTC two-year program. The two-year students must also have completed professional naval science courses by attending a Naval Science Institute during the first summer in the program followed by study on campus for the last two years. Calculus, physics, computer science, American military affairs, and national security policy have been prescribed as program requirements, and there has been a shift to stress engineering and hard sciences in the degree program.

The Air Force ROTC program consists of both two and four year programs which are conducted at 175 colleges and universities in all states except Alaska, Maine, Nevada, and Rhode Island. The curriculum includes instruction in the development of airpower, the Air Force today, national security forces in contemporary American society, Air Force management and leadership, and summer field training at USAF bases.

OFFICER CANDIDATE SCHOOL

A third method for the Services to meet the requirements for new officers is Officer Candidate School (Officer Training School in the Air Force). These programs provide the short lead time commissioning source necessary to respond to immediate surges in officer requirements, since the programs can be expanded or reduced in a relatively short period of time. The following table shows the lengths of the various OCS courses.

Graduate Education for Validated Billets

The purpose of the graduate education program in each of the services is to provide graduate level education in required disciplines in order to maintain an inventory of the necessary number of qualified officers to fill certain military jobs. Under this program, an officer graduate student may attend either a civilian educational institution or one of the two service institutions, the Navy Postgraduate School or the Air Force Institute of Technology. While these two schools are primarily used by the parent Services (including Marine Corps use of the Naval Postgraduate School), they also train some students from other Services.

The Naval Postgraduate School, located at Monterey, California, is a fully accredited graduate education institution. Curricula are generally of the same academic nature as those found in graduate level programs of study in science, engineering, and administrative science at civilian institutions, except that course content is, in some cases, unique to the Naval Postgraduate School and in other cases focused on naval and military applications.

The Air Force Institute of Technology at Wright-Patterson AFB, Ohio, also emphasizes military unique courses. The Resident School of Engineering offers courses in Aeronautical, Electrical, and Nuclear Engineering; Engineering Physics; and Systems Management. Courses offered at the School of Systems and Logistics are: Inventory and Decision Analysis; Financial Management in the Federal Government; Problems in Environment Protection; Logistics Systems Policy; Supply Management; and, Cost and Price Theory.

The table on the following displays FY 1974-1978 training load data for participants in this program, both civilian institutions and at the two service institutions. All participants are members of the Active Services.

TRAINING INPUTS, OUTPUT, LOADS, GRADUATE EDUCATION FOR VALIDATED BILLETS, FY 1974-1978

Service	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army	509	800	1189	592	680	1039	512	625	899	197	60	899	921	921
Navy	663	660	1276	694	740	1233	622	668	1049	386	287	1053	970	895
USMC	40	44	70	22	41	53	42	25	50	25	5	60	47	47
Air Force	798	1090	1552	1065	1054	1570	916	879	1300	322	291	1288	1190	1090
DoD Total	2010	2594	4087	2373	2515	3895	2092	2197	3298	930	643	3300	3128	2953

Other Degree-Completion Programs

In addition to the programs designed to satisfy validated requirements, there are several programs designed to permit selected individuals an opportunity to work toward or obtain an associate, baccalaureate or advanced degree. These programs benefit the services in several important ways: they increase the technical qualifications of the individuals in the program; they improve the general educational level of service personnel; and they provide career retention and recruiting incentives to outstanding personnel. In addition, whenever possible, personnel in advanced education programs are later used to satisfy validated requirements and hence reduce the required student load in graduate education for validated billets.

The degree-completion programs are managed by the individual Military Departments and each has its own selection criteria. However, in general a person is not selected for a program unless the education will enhance his professional development and be of use to the Military Department. All of the programs require a payback from the individual.

Load data for these programs for FY 1976-1977 are shown in the table on the following page. All participants are in the Active Forces.

TRAINING INPUTS, OUTPUT, LOADS, OTHER DEGREE COMPLETION PROGRAMS, FY 1974-1978

Service	FY 1974			FY 1975			FY 1976			FY 197T			FY 1977	FY 1978
	Input	Output	Load	Input	Output	Load	Input	Output	Load	Input	Output	Load	Load	Load
Army	1998	2001	2801	1526	2088	2374	1538	1423	1962	614	225	1617	1853	1853
Navy	1289	1446	2831	1063	1899	2067	118	1196	1084	58	49	199	210	210
USMC	396	357	613	322	391	538	227	337	416	103	24	224	317	317
Air Force	25	0	2	25	1	45	25	17	64	25	3	68	75	75
DoD Total	3708	3804	6247	2936	4379	5024	1908	2973	3526	800	301	2108	2455	2455

<u>Other Full-Time Education (Non-Degree Programs)</u>

Short-course training provides the Military services with needed skills in a wide variety of scientific, administrative and other fields. These programs are selected to train personnel in job-oriented skills which can best be acquired through abbreviated courses. Accounting, traffic management and aviation safety are examples of skills involved. Some of this included training is conducted in DoD schools, the remainder in civilian institutions.

TRAINING INPUTS, OUTPUT, LOADS, OTHER FULL-TIME EDUCATION, FY 1974-1978

Service/ Component	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Army														
Active	615	565	15	670	620	16	960	900	22	240	140	55	22	22
Reserve														
Natl.Guard														
Navy														
Active	2788	2756	378	3260	3106	403	3603	3591	458	949	745	413	489	507
Reserve	209	209	24	241	233	26	246	246	33	247	150	37	23	23
USMC														
Active														
Reserve														
Air Force														
Active	5039	5046	510	4524	4550	474	6199	6213	563	1567	1450	472	525	525
Reserve	58	58	4	211	211	11	175	175	10	39	39	16	10	10
Natl.Guard	115	115	8	182	182	10	162	162	9	19	19	12	9	10
DoD														
Active	8442	8367	903	8454	8276	893	10762	10704	1043	2756	2335	940	1036	1054
Gd/Res Total	382	382	36	634	626	47	583	583	52	305	208	65	42	43
DoD Total	8824	8749	939	9088	8902	940	11345	11287	1095	3061	2543	1005	1078	1097

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Health Professionals Education

This subcategory is made up of a wide variety of courses for personnel of all health professions -- physicians, dentists, nurses, medical administrators, etc. The majority of the courses offered are conducted in military medical facilities, and vary in length from a few days to a full year. Some training is conducted at civilian medical institutions, including, in the case of the Army, some (FY 1976 load: 245) advanced degree programs. The purpose of Health Professionals Education is to expand the skills of military medical personnel and to provide them timely information on the latest techniques in their fields. Educational programs connected with the acquisition of health professionals is carried in this report under Officer Acquisition Training.

The table on the following page shows load data for FY 1974-1978 for Health Professionals Education.

TRAINING INPUTS, OUTPUT, LOADS, HEALTH PROFESSIONALS EDUCATION, FY 1974-1978

Service/ Component	FY 1974 Input	FY 1974 Output	FY 1974 Load	FY 1975 Input	FY 1975 Output	FY 1975 Load	FY 1976 Input	FY 1976 Output	FY 1976 Load	FY 197T Input	FY 197T Output	FY 197T Load	FY 1977 Load	FY 1978 Load
Army														
Active							3389	3451	315	1212	1054	69	314	
Reserve														
Natl.Guard														
Navy														
Active	1032	911	856	956	978	916	903	791	837	451	213	1140	841	841
Reserve														
USMC														
Active														
Reserve														
Air Force														
Active	4046	3936	1162	3641	3670	1219	4704	4724	1329	1069	796	1808	1460	1460
Reserve	203	201	21	344	342	36	234	232	24	78	77	40	24	24
Natl.Guard														
DoD														
Active							8996	8966	2481	2732	2063	3017	2615	
Gd/Res Total							234	232	24	78	77	40	24	
DoD Total							9230	9198	2505	2810	2140	3057	2639	

Appendix 5-2 *

The Directorate of Instructional Technology (DFIT) has grown from a small film library and art shop to a directorate employing 80 people responsible for all of the Command's communication media activities -- photographic, television, training aids, graphics, and presentation services. DFIT has the responsibility of keeping abreast on new developments in education technology and advising appropriate Academy departments on educational technology innovations and ideas. To accomplish this mission, the Directorate is divided into six sub-divisions.

The Instruction Division teaches a non-credit course in academic skills, emphasizing good study habits and accelerated reading. A related typing course assures that all incoming cadets will type a minimum of 24 words per minute.

The Academic Television Division supports the instructor via closed circuit television from its central distribution center, or by mobile video cassette tape players. Additionally, the faculty and staff as well as the students may utilize a portable television camera and playback system for self-evaluation and confrontation exercises.

In Media Consultation, individuals work with clients in planning, directing, and designing projects requiring the total resources of the Directorate. Coordination is established to take a project from the initial design stages through production and presentation.

The Training Devices Division provides special three-dimensional instructional devices for the teaching of cadets. They either research, design and fabricate a device at the academic department's request, or the Division constructs or modifies the device from the department's exact specifications.

The Photographic Division produces a wide range of photographic products -- 16mm silent or sound motion pictures in color or black and white which can be reduced to super 8mm color slides, vugraphy transparencies, color prints, black and white prints, and metal photo plates.

The Graphics Division is a single point of contact for planning, directing, and producing visual products. They provide graphic design, illustration, typography, finished art and composition services for cadet instruction, USAFA presentations, public relations and information programs, the athletic program, recruiting literature and Academy informational brochures. They also assist in the production of textbooks, handbooks and other classroom reinforcement materials.

The self-help or "do-it-yourself" workshop serves to assist the cadet in the accomplishment of visual aids for grade determining classroom projects. It also provides a limited alternative to the instructor

* Submitted by USAFA staff in partial response to DSB Task Force inquiry.

for short suspense requirements. The area is equipped with drawing tables and the basic artists' materials for producing charts, maps, posters and other visual products.

In order to maintain awareness of new developments and innovations in education technology, DFIT personnel regularly review appropriate publications to identify new ideas and hardware which could be incorporated into Academy educational programs. DFIT personnel also participate in selected conventions and professional meetings such as the National Association of Education Broadcasters, the National Association of Broadcasters, and the Association of Educational Communications and Technology. Literature and documentation of interviews and sessions are collected at these meetings for use later by Academy personnel.

Appendix 5-3
Exerpts from the
Final Report on the Naval
Academy's CAI Project

PR-0571-43 February 1972

FINAL REPORT
ON THE
NAVAL ACADEMY'S CAI PROJECT

A Subproject of Navy Research and
Development Program ADO 43-03X

Conducted by
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See over for a list of documents supplementing this final project report.

FOREWORD

Required levels of personnel readiness and capability in the Navy are dependent upon education and training programs. To achieve improvements in the Navy's education and training program, the Chief of Naval Operations established Advanced Development Objective 43-03X, Education and Training. A stated objective of the ADO was to "test the feasibility of available new advances in training technology . . . as a means for providing and maintaining increased personnel capabilities." Amplifying data contained in the basic ADO document identified a number of advances, already achieved under the research and exploratory development programs, sponsored by the Department of Defense and developed by various institutions, that were judged to be ready for feasibility testing under the advanced development concept. One of the technologies so identified was the "use of computer-aided and other automated techniques in instructional procedures and content."

Following the establishment of ADO 43-03X on 6 April 1966, several efforts in computer-assisted instruction were proposed. Because the ADO designated "Career Development Training for Line Offi er" as a high priority substantive training area, a CAI effort was initiated at the United States Naval Academy, focusing on the development and utilization of computer-assisted instruction concepts and systems to improve the effectiveness of Navy officer education.

Another high priority area identified in the ADO was "Basic Electronics Training." An effort underway at the Naval Personnel and Training Research Laboratory, San Diego, is responsive to this requirement.

It is expected that these two projects will provide the information necessary for determining whether the systems and technologies evaluated should be accepted by the Navy for use in officer education.

IV. FINDINGS AND CONCLUSIONS

A. RELATIVE TO MAJOR GOALS

The major project goals, as stated in Chapter I, were to evaluate the use of the computer as a tool in performing certain instructional functions, specifically:

1. INDIVIDUALIZING INSTRUCTION

a. CAI enabled students to go through the materials at their own rate. In Russian, for example, some students completed the instructional material in six hours; some took 24 hours to go through the same material.

b. CAI enabled instructors to identify individual differences among students and to provide remediation for those who needed it. (However, as was noted, the Naval Academy does not provide the same wide range of individual differences as would be found in most civilian institutions of higher learning.)

2. FACILITATING SOLUTION OF COMPLEX PROBLEMS

The teletype gained great acceptance by both faculty and students because of its effective utilization in solving design and engineering problems. It was particularly effective in such courses as Underwater Acoustics, Fluid Mechanics, and Physics.

3. DETERMINING OPTIMUM COURSE CONTENT

a. The development of CAI course materials required instructors to be precise in stating behavioral objectives and, consequently, to re-evaluate course content. This was particularly true in Chemistry.

b. Some courses changed due to changing curriculum requirements which should be expected in any college environment. This caused problems in CAI material revision and data.

4. RECORDING AND ANALYZING STUDENT PERFORMANCE DATA

a. The computer aided the instructors in readily obtaining the data which indicated where students were having difficulty in mastering material and where course revision was necessary.

b. The methods for recording and analyzing data as well as for producing the materials and managing the program had to be developed. CAI theory and practice was at a primitive stage when this project started.

B. RELATIVE TO STUDENT ACHIEVEMENT, ATTITUDES, AND TIME

1. Teletype use increased the amount of subject matter covered in the courses. It particularly relieved students of the burden of large and complex manual calculations and provided more time to understand principles.

2. Computer use in the tutorial mode to supplement conventional instruction was more in the direction of increased course depth and quality than increased coverage, decreased cost, or relief from teaching "less appealing" parts of the course.

3. Teletype use was more successful in topics of greater difficulty and those requiring creative/intuitive thinking than in those involving rote-learning.

4. The teletype was an extremely powerful teaching tool in simulations, solutions of complex problems, laboratory data reduction and analysis. Eight courses were soon using these techniques operationally. It was less successful when using drill and practice and tutorial techniques. Three courses using these techniques did not go operational but were continued as research projects. Improved student achievement was not demonstrated using these techniques.

5. In the 1500 Project, there were no significant differences between the performance of the CAI groups and the control groups except in the

Russian course where the CAI group showed significantly better achievement than the control group.

6. In the 1500 Project, there were no overall time savings through the use of CAI for the students; however, the instructors were relieved of many of the problem solving and homework aspects of the course and could devote this time to other instructional duties.

7. Student attitude toward the tutorial type of CAI techniques was generally favorable, reaching a peak near mid-semester. Their evaluation on whether or not the CAI support had helped them was generally positive.

8. The more closely the student was connected to the computer and personally participated in the programming, (as in the CAI-Teletype Project), the better his understanding of the subject matter.

C. RELATIVE TO CAI TECHNIQUES

1. The non-computational techniques (drill and practice, tutorial, testing) did not result in the same degree of acceptance and enthusiasm by the faculty and students as did the computational techniques (problem-solving, simulation, data-reduction and formatting). These techniques cannot be compared directly on the basis of student achievement or time/cost savings.

2. Techniques which permitted the faculty and student to interact directly with the computer and participate by writing or changing the program (CAI-Teletype) were more widely accepted and used than techniques requiring a technical staff to do the programming (CAI-1500). Approximately 50% of planned academic year 1971-72 connect time will involve the use of problem solving, and over 20% will involve simulation techniques. Again, these two techniques cannot be compared directly on a basis of student achievement or time/cost savings.

D. RELATIVE TO UTILIZATION

1. Use of the teletype significantly increased student participation in the subject matter of the courses.

2. The use of teletype expanded very rapidly with additional faculty and midshipmen learning to write programs. The number of leased terminals installed doubled each year for three years. Use was limited by operational funds available for vendor service until the installation of a large time-sharing system (GE-635).

3. Growth of teletype use was Academy-wide rather than by academic discipline.

4. The 1500 system was not configured so that faculty and students could easily use it.

E. RELATIVE TO COMPUTER HARDWARE/SOFTWARE

1. The original enthusiasm shown by faculty and students diminished during the early stages; and expanded use of the system was in question for a time until both the teletype and 1500 systems were made highly reliable.

2. The 1500 system's capability to randomly access large video and audio files and to record data made it an excellent instructional research tool. Where configured for this type of work, however, its capacity to handle the many other educational computer needs, such as computational work, was severely limited.

3. The 1500 system was limited in its use to support a large student load due to the maximum of 32 terminals that can be used simultaneously.

4. The GE-635 proved to be exceptionally capable in handling the computational aspects of CAI (problem solving, simulation, and data reduction and formatting).

5. Computer language for the 1500 (COURSEWRITER II) is essentially a tutorial type language. This language had severe limitations in numerical calculations, string-processing capabilities, and in flexibility of programming. A great deal of effort was expended in training personnel and in using this language throughout the project.

F. RELATIVE TO STAFF AND SUPPORT REQUIREMENTS

1. The management of the support staff needed to properly prepare the educational material for use and to collect and analyze test data consisted of a diverse group of experts and technicians, whose coordination resulted in a highly complex operation.

2. The collection, management, and analysis of the test data relative to the amount of course material prepared required resources far in excess of what was originally anticipated.

3. Preparation of satisfactory material for CAI use required the author to have experience in using and improving his material repeatedly during its use in the CAI mode.

4. One of the most severe problems in producing and revising material for the CAI-1500 Project was the fact that most authors could not work directly with the computer. The programmer interface was an ever-present communications barrier unless the author either used clear, detailed Display Guides or learned the specialized COURSEWRITER II computer language.

5. Careful planning and timely production of teaching aids -- such as art work, film strips, and audio tapes to support the course material -- is absolutely necessary to the project.

6. Faculty changes due to rotation and loss affected the orderly execution of this project due to its long term nature.

C. RELATIVE TO COST

1. Use of the teletype for computational CAI techniques provides an estimated reduction in the order of 5-to-10-fold for solving problems and analyzing laboratory data as compared with "conventional methods." Cost of vended time shared service ranges from $4 to $6 per terminal hour, depending upon capability and degree of reliability of both the remote computer and communications. Cost may be as low as $2 to $3 per terminal hour for an installed time-sharing system. A student in one course making moderate to heavy use of computers (12 hours per semester) would therefore cost from $24 to $72 per semester. Such cost can be justified and considered cost-effective based on increased course level -- the incorporation of advanced concepts, techniques, and complex problems.

2. The use of a dedicated system similar to the IBM 1500 for non-computational CAI techniques is extremely expensive; and with the present state-of-the-art of CAI, it is evident that there are many alternate ways of providing the same teaching effectiveness at lower operational cost such as special programmed instruction texts.

3. Factors contributing to both CAI-1500 and Teletype Project costs, when the maximum staff was employed (1970-71):

	Average Cost Per Year
Hardware (IBM 1500 System)	$ 183,000
Vended Time-Sharing Service (Teletype)	60,000
Management Staff	81,000
Programming Staff	104,000
Consultants	30,000
Miscellaneous (travel/supplies)	20,000
Faculty (no summer hire during this period -- during 1968-69 was $30-40,000 per year)	--
Total Average Cost (1970-71)	$ 478,000

4. Development time for the CAI-1500 courses varied widely and required considerable effort to revise. The development time per student instruction hour using the IBM 1500 system appears so high that, unless it could be used for a large number of students for a long period of time, it would not be operationally cost-effective. The table below includes man-hours for authoring, programming, and computer operator support.

	Initial Development	Revision	Total	Development Time Per Hour Instruction
Naval Operations	2483	2543	5026	325
Russian	3675	2894	6569	183
Chemistry	Data Not Available		3810	317
Physics	Data Not Available		2545	424

5. The instructional material development costs can be reduced by imposing the following controls:

a. The instructional model should be fixed at an early stage.

b. Inputs by behavioral and educational technologist must be entered at a specific and optimized point (and as early as possible).

c. Research and evaluation design features must be realistic and specific at the start.

V. RECOMMENDATIONS

The following recommendations are addressed to those educational institutions (military or civilian) that may be contemplating CAI applications in their instructional programs. If an institution decides to become involved with the use of CAI, the following recommendations, based on the Naval Academy's experience and the present state of the art, may be helpful in minimizing time and cost while maximizing effectiveness.

1. Use of the CAI-1500 system for non-computational techniques (tutorial, drill and practice, testing) was not operationally or financially effective at the Naval Academy. It is recommended that, if a dedicated system is to be used operationally for instruction, the following conditions should exist:

- Reliable computer system is mandatory.
- Large numbers of students are necessary to reduce cost per student.
- Programs should be simple to write and easy to change.
- Instructional material should remain reasonably static so that frequent changes are not required.
- Considerable effort must be devoted to planning the production of the CAI materials and the data management subsystem.
- The system must be capable, not only of providing instruction, but of managing data on student performance.
- The institution must have personnel resources available to provide qualified support in many areas, such as psychology, educational technology, and computer programming.

2. From a cost-effective viewpoint, a dedicated CAI-1500 type of system is not recommended in a university environment for operational use. More hardware/software system development is required to reduce cost; and a great deal of educational technology research must be done to improve development of instructional materials as well as the management of student learning. The few courses involved and the relatively small portion of each course committed to CAI in the Naval Academy 1500 Project emphasized both the complexity of using these techniques and the dearth of existing knowledge on how they can be used successfully in a college environment. The effort that appears necessary to make CAI-1500 type systems operationally feasible is of such magnitude and requires expertise at such levels that it should be accomplished at educational institutions having advanced schools of education, where such expertise exists.

3. Use of the CAI-teletype system for computational techniques (problem-solving, simulation data reduction and formatting) was effective in improving the academic level of the courses involved and provided a powerful tool using techniques unavailable without the computer. It is recommended that, if this system is to be used for operational instruction, the following conditions exist:

- It is mandatory that the computer system be reliable.
- The terminal response time should be low (1-3 seconds).
- A simple, conversational computer language should be used.

4. On the basis of cost-effectiveness, CAI-teletype systems are recommended (and are being used by the military for educational purposes in most of the service academies and the senior service schools). The number and type of terminals and the software requirements can be tailored and easily changed to meet the unique requirements of each institution, military or civilian.

Appendix 5-4

Prior to 1972, the Naval War College curriculum was a series of "studies" largely oriented toward the international, domestic, and military implications of national strategy. The teaching methodology employed was a mix of some in-house lectures, a large number of lectures by outside visitors, seminars for group discussion of course readings and lectures, and individual preparation of a thesis-type term paper. In terms of packaging, the course comprised sequential time-blocks in the fields of international relations and regional political/economic studies. The course had been essentially the same for a number of years, with only minor additions to and deletions from the material covered.

Beginning in 1972, the curriculum content, teaching methodology, overall style, and student workload changed significantly. The course is now a structure of three independent trimesters or concentration - Strategy and Policy, Defense Economics and Decision-Making, and Naval Operations - each directed by its own faculty. All three teaching departments employ case-study instructional seminars and rely largely on in-house lectures tailored to supplement the curriculum directly. Outside lecturers, therefore have sharply declined, while required student reading and writing in preparation for seminars have increased substantially. Furthermore, examinations and grades were instituted to provide an objective method of evaluating student progress.

Appendix 6-1

THE ARI-RESEARCH PROGRAM IN FLIGHT TRAINING

Work Unit Category: Development of Methods for Evaluating Helicopter Pilot Performance

The assumption under which this work began in September 1973 at Ft. Rucker, Alabama with the concurrence of TRADOC and the support of the Aviation Center was that no meaningful recommendations could be made to the Army concerning rotary wing flight training until present pilot capability was established. The focus of this research has been on navigation at Nap-of-the-Earth (NOE), since earlier interviews with operational pilots had established anecdotally that this was a primary problem. A secondary measurement emphasis was aircraft control (piloting).

Although the framework of this work was on performance measurement, it dealt with two other variables: the effect of pilot experience on NOE flight; and the usefulness of ground school training in terrain analysis.

In the first series of tests which ran to approximately February 1, 1974, 14 pilots with a range of experience from 200 to 2700 flight hours were exposed to 12 flights (2 each day) which simulated operational combat conditions. Half of this group stood down for 2 days to receive a specially developed training course in terrain analysis; the other half did not.

In order to measure pilot performance quantitatively, a special measure was created which had 4 components: ability to identify the Initial Point; ability to identify landing zones on the route flown; and the number of 250- and 1000-meter deviations from the specified route.

The following results were noted: (1) Mean navigation performance of all subjects was .57 on a scale from 0 to 1.00, where 1.00 represented perfect performance; this suggests the need for much more intensive NOE-specific training. (2) Flight experience at altitude does not translate into NOE navigation capability, which means that regardless of experience, all pilots must receive NOE training; (3) Despite the crudity of the terrain analysis training given, subjects who received this training appeared to show some improvement in checkpoint identification; (4) Aircraft control experience at altitude rapidly generalizes to satisfactory aircraft control at NOE; (5) The special measure developed correlated .8 with subjective measures of the same performance secured from the instructor pilot, suggesting that the measure can be used validly for a variety of performance applications.

Subsequent to this first series of flight proficiency tests, it was decided that a larger sample was required for confidence in the results. An additional 14 pilots were selected, this time to represent the best NOE-qualified aviators in the Army. It was hoped that the performance of these pilots would indicate an upper bound to which flight training should

aspire. These pilots are currently being tested and should complete their work in October 1974. The performance of the first 7 pilots tested in this second series indicates superior performance although for reasons as yet unknown they tend to make many more 250-meter deviations from the specified route.

Projected Further Work in FY 1975

The following studies are planned for FY 1975:

1. Measurement of pilot navigational performance at low altitudes (approximately 100 feet) at night.

The work previously cited was performed in daylight. Since NOE flight must also be conducted at night, there is considerable interest in establishing how well pilots can navigate at night. Because of the absence of sensor instruments to aid the pilot's vision and thus to go down to NOE levels at night, it will be possible to fly only at what is termed "low level." It is therefore planned to conduct a series of flights parallel to those already performed, but this time at night, with two goals in mind: (a) to quantisize navigation/aircraft control performance under night time, direct vision conditions; (b) to determine the kinds of problems that may be encountered in setting up a nighttime low level training program.

Although it is expected that ultimately NOE at night will be flown with sensor displays, a quantitative measure of direct vision performance at night will be useful as a basis for comparison with performance to be achieved with sensors. In addition, the kinds of problems encountered will assist in setting up nighttime NOE training courses by indicating special aspects that should be emphasized in training.

2. Measurement of Pilot Performance at NOE at night.

In the absence of sensors, it is of course extremely hazardous to fly tru NOE at night. ARI has, however, developed special light-attenuating glasses which can be used to simulate various nighttime illumination levels. Under this arrangement the pilot in control of the aircraft will be flying with normal vision (without special glasses). However, the copilot/navigator will navigate with the light attenuating glasses. It will therefore be possible to measure navigation performance in conditions parallel to those of our present series of NOE flights and with complete safety. A series of such flights will be conducted and measures applied. As in the case of the low level flight effort described previously, the resultant data will indicate what can be achieved in the way of navigation at NOE via the direct eyeball.

Work Unit Category: Effective Aircrew Performance

Projected FY 1975 Effort

Efforts under the Effective Aircrew Performance Work Unit Category will

be directed at establishing the utility of motion picture technology for training NOE navigation. Results of previous studies suggest that use of navigational motion pictures in ground training can lead to substantial gains in navigation performance and possibly concurrent reduction in the number of actual flight hours required for training.

In pursuit of this objective films of NOE flight are being made. A study will be performed in which graduates of the IERW classes at Ft. Rucker will be given systematic training with these NOE films and then performance in NOE flight will be contrasted with an equated group of pilots who do not receive this training. The study to be performed is a classic pre- and post-transfer of training experiment which is scheduled to begin approximately 15 January 1975. The output of this study will determine to what extent one can rely on dynamic ground school methods to train NOE daylight navigation as well as possibly other flight skills.

Technology-Based Research

Research on pilot reactions to obstacle avoidance situations began in Spring 1974 when video films of 3 types of commonly encountered obstacles (trees, power lines and wires) were recorded under NOE conditions. An experiment was then performed to study the reaction times of pilots viewing these films as a function of the following variables: (a) speed of aircraft (20, 40, 60 knots) and shape of the obstacle. Twenty experienced pilots from Ft. Belvoir viewed these video recordings on a television screen and operated a control stick (representing the collective and cyclic) to fly over or to either side of the obstacles, in accordance with an operational mission scenario they had memorized. They were instructed to move their control stick as soon as they detected one of the three obstacles.

Complete data from this experiment are now being analyzed, and so are not available. When the results are available, however, they will be relevant to the speed at which one can safely fly at NOE to avoid obstacles. The results will also be used to help specify behavioral requirements for night obstacle avoidance devices, such as magnification, resolution, sensor slant angle and field of view.

Project Further Work in FY 1975

Using the films described above, further experiments are planned using similar techniques to investigate the effect of display illumination on obstacle detection. This will have a bearing on the illumination requirements for obstacle avoidance sensor displays when the latter become operational.

Another study making use of motion picture technology will seek to determine the effect of various levels of illumination on navigation performance. Initial studies indicate that it is possible to secure reasonable measures of NOE navigation performance by presenting short sequences of films which reproduce significant checkpoints along a specified route. The

pilot subject watching these films is given a map with the initial point marked and the general direction of flight; he must then locate his motion picture position on a standard 1:50,000 scale map. In studying illumination level effect a light attenuating filter is attached to the motion picture projector lens which then simulates the visual environment as it would be under various degrees of illumination. The results of this study should pinpoint the point at which navigation performance starts to degrade and will suggest at what illumination levels sensor-aiding equipment is necessary.

Work Unit Categories: Development of a Laboratory Test-Bed for Pilot Performance Studies

Work is being performed on the development of specifications for a visual simulation research facility which will permit the performance of highly controlled laboratory studies of the visual parameters affecting NOE flight. The emphasis in the preceding studies described has been on field tests and field-created stimuli (e.g., films). The degree of precision with which one can study flight variables is necessarily reduced by the lack of control and replication inherent in the field environment. It seems reasonable to assume that visual elements (e.g., field of view, resolution), influence pilot performance extremely.

ARI is therefore attempting to develop a visual simulation research facility which will permit the reproduction of the pilot's visual environment at NOE. This device will utilize a three-dimensional terrain table, a slaved optical probe and a cockpit work station with suitable controls. Such a facility will aid in the determination of:

1. the pilot's visual detection and recognition capabilities under varying illumination levels, backgrounds and dynamic flight conditions;

2. the cues he uses for geographical orientation;

3. his target acquisition capability relative to target type and background; and

4. his performance responses under fatigue and stress.

They will also permit the investigation of his capability to utilize new sensor displays such as LLTV, helmet-mounted displays, etc.

There are special problems in developing such a facility. The extremely low altitude to which the optical probe must go in order to reproduce what the pilot sees at almost ground level poses a major engineering problem in display resolution and probe responsiveness. To assist in the solution of these problems, a contract has been let to Martin-Marietta Corporation at Orlando, Florida, to help develop engineering specifications for the device. The results of this study contract will also be useful in the future development of Army simulators for training pilots to fly at NOE.

Title: Modernization of Synthetic Training in Army Aviation - SYNTRAIN

Background: The general objective of Work Unit SYNTRAIN is to expand the training and simulation technologies pertinent to Army aviation simulation and training device programs. Emphasis is on training technology applications in the design and utilization of Army synthetic training equipment. The general orientation of this effort has been that how a device is used is the most critical factor in producing cost benefits, so attention is paid to training program design and hardware design for training. Much of this research has focused on the development and utilization of Device 2B24 of the Synthetic Flight Training System (SFTS). This work has been conducted under ARI contract by HumRRO.

FY 1975 Activities: Training research concerned with enhancing the operational use of available simulation equipment is continuing. Principal activity is an investigation of the optimum use of Device 2B24 in Army undergraduate helicopter pilot training (UPT). This investigation seeks to determine the limits of potential use of the nonvisual 2B24 in meeting general training objectives of Army UPT as well as for the instrument graining objectives for which the 2B24 has already demonstrated its utility. An additional area of investigation concerns development of automated training and measurement technology with the 2B24.

A final area of concern is assistance to the Army in the design and development of simulators for the CH-47 (Device 2B31) and AH-1 aircraft (Device 2B33). These two devices will be the first Army aviation simulators with visual display systems.

Post FY 1975 Projections: The activities described for FY 1975 will likely carry forward into FY 1976. Completion of the work on optimizing use of the 2B24 in Army UPT will likely carry into FY 1976 because of extreme shortages of instructor pilots at the U.S. Army Aviation School. The same factor complicates the automated training and measurement technology area. The development and operational suitability testing of Devices 2B31 and 2B33 will continue. The 2B31 is due to be delivered to Fort Rucker and operational suitability testing begins about March 1976, while the 2B33 is scheduled to begin suitability testing about June 1976. Thus, to carry these projects through to the point of their implementation into Army flight training will require effort into FY 1977. A number of other areas of simulation research closely related to Work Unit SYNTRAIN are envisioned as critical to Army aviation, but they are not treated here.

Projected FY 1976 and 1977 Efforts

The projects described below are a proposed program of aircrew performance research in support of Army aviation. The major study areas to be covered are:

1. Performance measurement and evaluation which include the development of more sophisticated assessment methodology, baseline measurement of crew proficiency, and investigations directed at measurement of proficiency losses.

2. Special attention will be given to NOE flight training, ground school, and special avionic training.

3. Training devices will receive special emphasis, particularly visual fidelity requirements and the utilization of synthetic flight trainers.

4. In the areas of displays, attention will be paid to display design parameters, particularly as they relate to the effect of visual parameters on displays for new sensor devices to aid the pilot.

5. Efforts will be made to investigate the workload supportable by pilots under NOE daytime and nighttime conditions.

Appendix 6-2

NTEC R&D PROJECTS RELATED TO FLIGHT TRAINING

Description		FY 74 Current	FY 75 Budget	FY 75 Def	FY 76 Budget	FY 76 Def
Improved Air Weapon System Training F55.522.419		600	407	1123	460	1498
Improved Air Weapon System Training	NTEC 060	525	356	892	380	953
Automated Naval Weapon Sys. Trng.		100	100	36	0	140
Maintenance Training for Avn. Sys.		100	0	144	--	--
Advanced Technologies for Controller Training		100	80	70	116	100
Human Performance Measurement in Air Systems		--	0	174	0	175
Transfer-of-Training		225	116	384	164	338
Instructor Pilot Role in Simulator Training		--	60	84	100	200
Improved Air Weapon System Training		--	0	171	75	500
IR Display Training Req's.		--	0	121	75	60
LSO Training Requirements		--	0	50	0	60
RPV Training		--	--	--	0	130
Inexpensive Trainer Design		--	--	--	0	250
Improved Air Weapon System Training	NADC 001	70	100	60	0	45
Automated Electronic Weapon System Training		70	100	60	0	45
Travel		5	5		5	

NTEC R&D PROJECTS RELATED TO FLIGHT TRAINING (cont.)

Description	FY 74	FY 75		FY 76	
	Current	Budget	Def	Budget	Def
Tech. in Naval Aviation Training Equipment F55.522.415	548	523	1211	546	1696
Tech. in Naval Avionics Training Equipment NTEC 060	545	520	1811	543	1695
Holographic HUD for Avionics Tng.	90	8	0	0	0
FLIR Sensor Simulation	94	90	40	35	0
Computer-Generated Visual Display	98	125	75	150	60
Laser Air-to Air Gunnery Trainer	58	78	0	0	0
Laser Helo Gunnery Trainer	65	42	0	0	0
Film Image Gen. for Training	30	80	206	120	200
Air-to-Ground Fire Simulation	--	0	100	0	100
Annular Panoramic Project Dev.	--	0	180	0	180
360^{o} Holographic Display	--	0	53	0	53
Air-to-Air Combat Spin Recovery Tnr.	--	0	31	0	31
Wide Angle-Hi Res Color for Tng.	--	0	199	76	124
Helo Flt. Motion/Visual System Eval.	--	0	121	0	126
Simulation Computing Techniques	--	50	120	120	135
Plotting Projector for Tng. Dev.	--	0	50	0	50
PPV Pilot Trainer	--	0	49	0	49
Hi Res Insetted Raster	60	47	0	42	0
Photo Memory	--	0	51	0	51
VTOL Aircraft Math Model	--	0	126	0	126
Landmass Data Base Sensor Sim.	50	0	290	0	290
Maintenance Training Equipment	--	0	120	0	120
Travel	3	3		3	

APPENDIX 6-3

SPECIFIC PROGRAM ELEMENTS IN SUPPORT OF NAVY FLIGHT TRAINING

NAVY FLIGHT TRAINING - FY 1975

	Source of Training Technology R&D Support	
Flight Training Requirements (& procedures)	PE 61153-41	Biological & Medical Science "Air-to-Air Visual Target Acquisition" $170 thousand
Flight Familiarization Training	None	
Warrant Officer Pilot Training	N/A	
Undergraduate Pilot Training	PE 63720	Education & Training: W43-08 - Wide Angle Vision - Training Device Tech. for Advance Simulation Training Systems $3070. P43-03 UPT Data Mgmt. Sys. $200 thousand.
	PE 63707	Manpower Management: W43-13. Human Factors Engineering Technology $730 thousand.
Undergraduate Navigator Training	None	
Other Flight Training	PE 62763	Human Resources - NAVAIRSYSCOM program in support of all types flight training, including UPT. Program changes from year to year. $1 million
Advanced Flight Training	PE 62758	Bio-Medical Technology: "Criteria for Fleet Effectiveness." $250 thousand

APPENDIX 6-4

HRL-FTD PROGRAM OF RESEARCH IN FLIGHT TRAINING

RPR	TITLE	TASK/WORK UNIT	TITLE	MANAGER
		1123-03	EXPLOITATION OF FLIGHT SIMULATION IN UNDERGRADUATE PILOT TRAINING	SMITH
	TECHNOLOGY BASE	1123-03-01	ADVANCED SIMULATION IN UNDERGRADUATE PILOT TRAINING UTILIZATION	SMITH
72-16	T-4G EVALUATION PROGRAM	1123-03-03	USE OF THE T-4G SIMULATOR IN THE T-37 UPT SYLLABUS	WOODRUFF
73-37	UPT TASK FREQUENCIES AND TASK MANEUVER TIMES	1123-03-06	UNDERGRADUATE PILOT TRAINING TASK FREQUENCIES	BROWN
73-21	ADVANCED SIMULATION IN UPT	1123-03-07	HANDBOOK OF RESEARCH DESIGNS	GRAY
73-18	F-4E WSTS #18 FLIGHT SIMULATOR	1123-03-09	F-4E MODEL PROBE VISUAL SYSTEM APPLICATION	BROWN
73-19	SIMULATOR FOR AIR-TO-AIR COMBAT (SAAC)	1123-03-11	EVALUATION AND TRAINING EFFECTIVENESS OF THE SIMULATOR FOR AIR-TO-AIR COMBAT (SAAC)	SMITH
72-18	IMPROVED SCREENING FOR UPT	1123-03-13	T-40 SCREENING STUDY	LEMASTER
73-27	APPLICATION OF T-4G METHODOLOGY TO T-4/T-37 AND T-26/T-38 SYLLABI	1123-03-15	APPLICATION OF T-4G METHODOLOGY TO T-4/T-37 AND T-26/T-38 SYLLABI	SMITH
	TECHNOLOGY BASE	1123-03-16	EFFECTS OF VARYING DISPLAY PARAMETERS ON TRAINING IN THE T-4G FLIGHT SIMULATOR	WOORRUFF
	TECHNOLOGY BASE	1123-03-17	COGNITIVE PRETRAINING OF THE T-37 OVERHEAD PATTERN	WATERS

TRAINING INNOVATIONS BRANCH PROGRAM

	TITLE	WORK UNIT	TITLE	MANAGER
	Objective Pilot Performance Measurement	1123 01 08	Development of an Automated Objective Performance Measurement System for ASUPT	Dr Waag
	Objective Pilot Performance Measurement	1123 01 10	Visual Cue Utilization During Flight	Mr LeMaster
	Objective Pilot Performance Measurement	1123 01 11	Measurement of Aircrew Performance Under Task Loading	Capt Thorpe
	Technology Base	1123 01 12	Automated Measurement Formation Flight Trainer	Mr Reid
	Technology Base	1123 02 05	Flying Training Research on Airborne and Ground Training Systems	Mr Reid
5	Audio-Visual Instrument Trainer	1123 02 14	Audiovisual Instrument Trainer	Dr Eddowes
	Technology Base (formerly 72-22, UPT Formation Trainer)	1123 02 15	FFT Application to UPT	Mr Reid
	Technology Base	1123 02 17	A Behavioral Taxonomy of Undergraduate Pilot Training	Dr Eddowes
8	Improved Screening for UPT	1123 05 01	UPT Student Perceptions of Training Difficulties	Dr King
3	Navigator Training Attrition Study	1123 05 03	Navigator Training Attrition Study	Maj McKenzie
	Technology Base	1138 01 06	Investigations of Training Methods and Instructional Technology	Mr Reid
	Technology Base	1138 01 07	Visual and Auditory Information Processing	Capt Thorpe

SYSTEMS ENGINEERING BRANCH

RPR	TITLE	TASK/WORK UNIT	TITLE	MANAGER
	SUPPORT REQUIREMENT	1192-04	ASUPT MAINTENANCE SUPPORT AND SPARING	RICHESON
	SUPPORT REQUIREMENT	1192-04-01	COMPUTER MAINTENANCE CONTRACT (SEL	GRIFFIN
	SUPPORT REQUIREMENT	1192-04-02	VISUAL SYSTEM MAINTENANCE CONTRACT (GE)	GRIFFIN
	SUPPORT REQUIREMENT	1192-04-03	SIMULATOR MAINTENANCE CONTRACT (SPD)	GRIFFIN

SIMULATOR APPLICATIONS BRANCH

RPR	TITLE	WORK UNITS*	TITLE	MANAGER
73-21	ADVANCED SIMULATION IN UNDERGRADUATE PILOT TRAINING	1123-03-	DEVELOPMENT OF ASUPT AS A CRITERION DEVICE	GRAY
73-21	"	1123-03-	USE OF ASUPT IN A TOTAL TRAINING ROLE	
73-21	"	1123-03-	ASUPT MOTION, VISION, "G" SEAT INTERACTION	
73-21	"	1123-03-	INVESTIGATION OF CHECK PILOT RELIABILITY	
75-**	NIGHT VISUAL SIMULATOR TRAINING FOR UPT	1123-03-	VISUAL DISPLAY BRIGHTNESS AND MOTION INTERACTION	
	TECHNOLOGY BASE	1123-03-	EFFECT OF FATIGUE ON PILOT PERFORMANCE	

* NEW WORK UNITS PLANNED
** ATC PROPOSED RPR

RPR	TITLE	WORK UNIT	TITLE	MANAGER
74-32 [1]	Study of Air Training Command Instructor Pilots	1123 05 06 [2]	Study of the Air Training Command Instructor Pilot	Dr King
74-33 [1]	Optimization of Formation Flight Trainer	1123 02 22 [2]	Formation Flying Skill Acquisition	Mr Reid
73-21	Advanced Simulation in Undergraduate Pilot Training	1123 02 18 [2]	Development and Evaluation of Automated Error Discrimination Instruction for Flight Simulation Application	Ms Martin
73-21	Advanced Simulation in Undergraduate Pilot Training	1123 02 19 [2]	Development and Evaluation of Simplified Instructions for the Acquisition of the Normal Landing	Ms Martin
73-21	Advanced Simulation in Undergraduate Pilot Training	1123 02 20 [2]	Investigation of Alternative Instructional Strategies for Basic Instrument Flight Training	Ms Tyler
73-21	Advanced Simulation in Undergraduate Pilot Training	1123 02 21 [2]	A Study of ASUPT Preprogrammable Flight Demonstration Capabilities	Ms Tyler

NOTES: 1. Proposed RPRs
2. Proposed Work Units

Appendix 6-5

HRL-FTD TECHNICAL REPORTS ON FLIGHT TRAINING RESEARCH

1970
TECHNICAL REPORTS
AFHRL/FT

No./AD.No.	Title	Author(s)
70-22 AD 727024	The Development, Test, and Evaluation of Three Pilot Performance Reference Scales	T.L. Radinsky W. Horner T. Fitzpatrick
70-30 AD 723311	Continuously Adaptive vs. Discrete Changes of Task Difficulty in the Training of a Complex Perceptual-Motor Task	M. E. Wood
70-31 AD 723313	Improved Crew Member Training Through a New Philosophy Toward Training (a paper)	M. E. Wood
70-33 AD 727025	Airborne Audio-Video Recording Design Considerations (Supported AVS)	M. E. Wood W. V. Hagin
70-34 AD 728685	Single-Concept Films in the Training of Flight Skills	M. E. Wood
70-38 AD 727054	Effects of "Real World" Radio Chatter on Mid-Phase Instrument Ground Trainer Proficiency: A Pilot Study	R. A. Goebel R. L. Williamson D. R. Baum
70-40 AD 728687	An Assessment of Two Methods of Sequencing Ground Trainer Practice for Undergraduate Pilot Training: Block vs. Alternating	W.V. Hagin G. B. Reid

1971
TECHNICAL REPORTS

No./AD.No.	Title	Author(s)
71-05 AD 731191	An Evaluation of Three Possible Explanations of the Temporal Decay in Predicting Pilot Performance	C. L. Hulin K. M. Alvares
71-06 AD 732612	Three Explanations of Temporal Changes in Ability - Skill Relationships: A Literature Review and a Theoretical Analysis	C. L. Hulin
71-07 AD 736613	The Effects of the Men on the Task in Complex Man-Machine Systems	C. L. Hulin K. M. Alvares
71-14 AD 732611	Multi-Media in USAF Pilot Training	M. E. Wood

71-18 AD 732616	Development of Automated GAT-1 Performance Measures	R. A. Goebel J. Hill
71-20 AD 738818	Evaluation of An Airborne Audio Video Recording System for a Head-Up Display Equipped Aircraft (used by TAC in Air Force programs)	J. A. Fitzgerald
71-36 AD 727009	What's New on the Training Horizon?	D. O. Andersen W. V. Hagin
71-50 AD 741747	Using a Ground Trainer (GAT-1) in a Job Sample Approach to Predicting Pilot Performance	R. A. Goebel D. R. Baum W. V. Hagin

1972
TECHNICAL REPORTS

72-8 AD 754973	Design of a Simplified Formation Trainer	M. E. Wood W. V. Hagin
72-10 AD 907096(L) No AD # AD 907097(L) AD 907098(L)	Navigator-Observer Utilization Field Flying Specialties Study Part I. Final Report (U) Part II. Appendix I. Present and Future Rolls of the Navigator (Secret) Part III. Appendix II. Common and Non-Common Operational Task Requirements (U) Part IV. Appendix III. Development of Training Requirements (U)	C. A. Semple, Jr R. J. Heapy E. J. Conway K. L. McArjel
(L) Limited Distribution		
72-11 AD 739190	An Instructional Manual for Using Performance Record Sheets Designed for Primary Pilot Training (This was written in 1952 but only submitted to DDC in March 1972)	J. F. Smith
72-55 AD 744041	Evaluation of Airborne Audio-Video Recording as a Tool for Training in the A-7D TAC Fighter (used by TAC)	J. A. Fitzgerald D. L. Moulton
72-61 AD 759171	Dynamic Observation in T-37 Undergraduate Pilot Training (UPT) Link Trainers (T-4)	R. R. Woodruff W. V. Hagin
72-62 AD 767580	Selection and Analysis of Undergraduate Pilot Training Maneuvers for Automated Proficiency Measurement Development	D. R. Baum J. F. Smith R. A. Goebel
72-63 AD 754850	Response Factors and Selective Attention in Learning from Instructional Materials: An Annotated Bibliography	C. L. Taylor

72-71	Learning Center Evaluation	L. H. Baer
AD 7605[illegible]	Part I. Measurement of Students' Attitudes Toward Undergraduate Pilot Training Learning Center (applied ATC)	
AD 760539	Part II. Teaching an Undergraduate Pilot Training Academic Course in the Learning Center	J. D. Beggerly

1973
TECHNICAL REPORTS

73-48	Use of Inferred Objectives with Non-Objectives-Based Instructional Materials	C. L. Taylor
73-67 AD 775043	An Examination of Some Behavioral Correlates of Air Force Undergraduate Pilot Training Through Use of the Porter & Lawler Performance/Satisfaction Model (ATC utility)	D. P. Lohmann
73-71	Media Adjunct Programming: An Individualized Media-Managed Approach to Academic Pilot Training (ATC applied)	B. L. McCombs R. A. Marlo
AD 775723	Vol I. Executive Summary	M. A. Sprouls
AD 779950	Vol II. An Individualized Media-Managed Approach to Academic Pilot Training	A. J. Eschenbrenner G. B. Reid
73-72 AD 783240	Further Development of Automated GAT-1 Performance Measures	J. W. Hill E. E. Eddowes

1974
TECHNICAL REPORTS

74-8 AD778073	Transfer From Audiovisual Pretraining to a Continuous Perceptual Motor Task (technology base)	M. E. Wood V. S. Gerlach
74-33	Development of a Behavioral Taxonomy of Undergraduate Pilot Training (UPT) Tasks and Skills,	Robert P. Meyer E. E. Eddowes
	Vol I. Executive Summary	
ADA000053	Vol II. Surface Task Analysis, Taxonomy Structure, Classification Rules & Validation Plan	
	Vol III. Taxonomy Refinement, Validation and Operations	
74-44 AD 786412	Syllabus and Syllabus Development Techniques Used in Evaluating the A/F37A/T-4G Flight Simulator	Steven K. Rust James F. Smith Robert R. Woodruff

74-52 AD 786850	The Value of an Air Combat Maneuvering Range to the Tactical Air Command	J. A. Fitzgerald
74-55 AD 786427	The Empirical Derivation of Equations for Predicting Subjective Textual Information	Dan Kaufman Mike Johnson Gene Knight (Gary Reid)
74-61 AD 786413	Use of the T-4G Simulator in USAF Undergraduate Pilot Training (UPT), Phase I	Robert K. Woodruff James F. Smith Robert A. Morris
74-63 ADA000046	A Cognitive Model of What is Learned During Flying Training	Edward E. Eddowes

APPENDIX 6-6

TRAINING SYSTEMS EFFECTIVENESS EVALUATIONS

Early History:	Vehicle	Simulator	Skills Taught	Experiment	Results
1939, (Ref. 1) (Nat'l. Res. Council, Wash., D.C.)	Civilian light aircraft	Link AN-T-18	Basic contact flight for Civilian Pilot Training Program.	Analysis of performance records. (N=10) No control group.	Estimate that 5 to 7 hrs. in trainer was equiv. to 3 hrs. in A/C. Savings of 2 to 4 hrs. air time. (Inconclusive).
1940, (2) (NRC, Wash., D.C.)	Civilian light A/C.	Link AN-T-18	Basic contact flight for Civilian Pilot Training Program.	Analysis of performance records. (N=10) No control group.	Estimated 2 1/2 hrs. saving in air time with 6 hrs. of trainer time. (Inconclusive).
1941, (3) (NRC, Wash., D.C.)	Civilian light A/C.	Link AN-T-18	Basic contact flight for Civilian Pilot Training Program.	Instructor performance ratings. Three groups of 14, 8, and 11 Civilian Pilot Training students.	Groups with more Link trainer time were rated higher than group with only one hour of training. (Inconclusive).
1942, (4) Naval Reserve Aviation Base, Long Beach, Calif. (later transferred to Los Alamitos base)	Military A/C	Link	Basic flight training	(N=146) no control group	(1) Reduced number of dual instruction hrs. for solo. (2) Reduced no. of students receiving downs on their check flight. (Doubtful conclusions for each of control group)
1943 (5) Naval Flight Preparatory School, William Jewell College, Liberty, Missouri.	Military A/C	Contact Link	Basic flight training	N=1400) 1/2 received 10 one hr. sessions on Contact Link Trainer. Other 1/2 no synthetic training.	Experimental students tended to slight advantage over control students in capable solo time, solo time, and instructor's grade. (Differences were not statistically significant.)

Early history

	Equipment	Simulator	Skills Taught	Experiment	Results
1946 St. U. of Iowa 57-1-1 57-1-3 57-1-4	Floating reticle sight	3-A-2 3-A-35 Aerial Gunnery Trainers	Leading an aircraft target	5 groups of N=20 each. Grp 1: Standard 3A35 (track and lead visible correct point of aim) Grp 2: Only tracking point of aim; then tracking and leading Grp 3: Standard 3A3 (small target movement) Grp 4: 3A2; then 3A5 Grp 5: 3A35 "on target" lights (correct point of aim not visible) Transfer test: 3A35 with no visible correct point of aim.	a) No differences among training methods. b) Trainees improve with practice c) Ceiling reached early; data suggest further training (esp. "on target" lights might raise final level.)
1946 Tufts College 58-1-1 58-1-2 58-1-4	Anti-aircraft Mk 18 Gunsight	3-A-40 Mk 18 Coordination Trainer	Simultaneous tracking and ranging	Exp. 1 (N=3 each): Exp. grp. given cues in earphones for "under" or "over" range on alternate trials for 20 trials; dropped for next 12 trials.	Both grps asymptote at 12th trial. Supplementary cue (augmented feedback) aids ranging performance but not learning.
				Exp. 2(N=5 each): Same as Exp. 1 except grps matched, based on 1st trial scores.	Earphone group obtained slightly bigger advantage--till earphones removed.
				Exp. 3(N=5 each): Exp. Grp. trained on 5 different target cycles. Control Grp on 1 target cycle (path).	1 target cycle group performed better (due to familiarity with path)
				Exp. 4(N=5 each): Grp 1: Practice on 1 target cycle (25 trials). Grp 2: Practice on 5 target cycles	Transfer scores (2 trials) for Grps 1 and 2 nearly as high as for learned courses. Grp 3 scores like 1st and 2nd trials

Early history (Cont'd)

	Equipment	Simulator	Skills Taught	Experiment	Results
				(25 trials). Grp 3: Little practice (2 trials) Transfer test: unfamiliar target cycles.	of learning. (High degree of transfer demonstrated)
1947 St. U. of Iowa 57-1-5	Floating reticle sight	3-A-2 Aerial Gunnery Trainer	Leading an aircraft target	Exp. 1: N=12 32 trials a day (22 min.) for 17 days. (4 identical blocks of 8 attacks). *1st 3 blocks each* day was practice (correct point of aim visible). For 4th block correct point of aim not visible. 18th day used different (more difficult) attacks (transfer test).	Learning: Performance much better when point of aim visible, and learning curve *steep* till 6th session. Test trials learning curve has gradual increase then spurts at 14th trial. Transfer: Considerable (50% of scores of familiar, easier attacks).
1947 Tufts College 58-1-5	Anti-aircraft Mk 18 Gunsight	3-E-7 Ranging, tracking Aiming Point Assessor	Simultaneous tracking and ranging	N=3 For each of 10 days received 60 trials (consisting of 4 different pursuit attacks)	Meter scores were unreliable, but graphic records showed rapid improvement on early trials for azimuth, elevation and range. In other respects the curves differed. For azimuth no S improved after trial 18. In elevation there was improvement till trial 48. In ranging, there was great variability for all S's.

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Early History (Cont'd)

	Vehicle	Simulator	Skills Taught	Experiment	Results
1945 (6) Naval Air Station Memphis, Tenn.	Military A/C	12BK-1 Primary Landing Trainer	Primary training	(N=166) 1/2 experimental and 1/2 control	(1) Experimental students completed syllabus faster than controls by 16%. (2) Control group had 10% more flight failures in A stage, 5% more in B stage (3) Differences disappear by end of C stage.
1949 (NTDC) 151-1-18 (Univ. of Illinois) NAS, Pensacola, Fla.	SNJ	(1) 12-BK-1 Landing Trainer C-3 Cycloramic Link Trainer SNJ Cycloramic (General) Link (1-CA-2)	instr. train. and control skills	(1) experienced S's (solo flt. time) (N=234) (2) 10 hrs. syn. trainer (N=465) (3) vs. control group (N=427)	Three trainers equiv. accidents reduced 40%; failure rate down 33%
1949 (NTDC) 71-16-5 (Univ of Ill. and Link Av.)	SNJ-5 Mod. for civilian use.	SNJ Cycloramic Link (1-CA-2)	basic contact flt. training	(2 groups of 6 college students ea.) 12 hr. flt. syllabus. Trainer group: 8 hrs. on trainer. Control gr: 11 hrs. A/C.	12 hrs. to learn in air; 5 hrs. air time for trainer group. Fewer errors for trainer group.
1950 (NTDC) 999-1-1	PBM PB4Y	PBM-OFT PB4Y-OFT	familiar. & instr. training.	series of controlled experiments using 23 matched prs. of students for each trainer	time in air reduced. FAM phase: No. INST phase: Yes. 1 - 1 1/2 hrs. out of 12 hr. syllabus. Fewer errors.

Early history (Cont'd)

	Equipment	Simulator	Skills Taught	Experiment	Results
1953 Dunlap & Assoc. 1043 -00-2	Anti-air-craft Mk 18 Gunsight	3-A-40b	Simultaneous tracking and ranging	Grp 1 (10 aircrewmen): 3-A-40b Grp 2 (10 aircrewmen): Standard squadron in the air. Grp 3 (10 aircrewmen): No aerial gunnery training Transfer test: Fire guns from P2V bomber at an attacking F9F aircraft. (Camera rather than bullets used to record performance.)	a) No differences in tracking scores. b) Tendency for air-trained and untrained groups to range better. c) Trainer - trained and air-trained groups equivalent and superior to untrained group on simultaneous tracking and ranging ("success score").

Summary of above aerial gunnery studies: The studies resulted in ways to modify the devices and in recommendations for improving training. However, the primary concern of the E's was to obtain basic data on the learning of tracking skills. The evaluations of the training devices, per se, were in the nature of a secondary fallout. That is, for the transfer experiments, no attempt was made to obtain transfer measures in an operational situation. Instead, transfer consisted of test trials on the trainer with unfamiliar target speeds and courses.

Early History (Cont'd)

	Vehicle	Simulator	Skills Taught	Experiment	Results
1950 (NTDC) 71-16-7	A/C	School Link with "blackboard" runway	ground reference maneuvers (landings, forced landings, pylon 8's	N=20 college students 10 on trainer 10 principles training	trainer group = 2.59 errors control group = 4.27 errors
1954 (NTDC) 999-2-1 NAS, Pensacola	SNJ	SNJ OFT (Specialized, high fidelity)* and NavBIT (General, low fidelity)**	instr. train including radio range	progress-at-own-rate syllabus & ground training under a blocked sequence Std. Blk Syl NavBit N=96 OFT N=33 Exp. Block Syl N=168 N=52	(1) saved an av. of 1.3 hrs. in flight or >3000 hrs/yr or, 1 flight out of 11 bas. inst. flts. (2) NavBIT equal in effectiveness to SNJ OFT for basic instrument training and slightly superior for radio range work.
1954 (A.F.) TR-54-38 Lackland AFB, Texas	F-6 (SNJ)	P-1 (1-CA-2) SNJ Cycloramic Link	procedures; maneuvering	95 aviation cadets; 47 in trainer. Substituted 40 simul. hrs. for 30 flt. hrs. in a 130 hr. syllabus	40 sim. hrs. + 30 flt. hrs. ration = 0.75

* NavBIT: the standard Navy synthetic trainer for basic instrument and radio range practice. Greater stability than SNJ OFT; "crab" which tracks record of flight path; additional headsets;

** SNJ OFT: a high fidelity electronic trainer which simulates the SNJ aircraft. Accurately simulates A/C characteristics (e.g. motion and sounds).

Early History (Cont'd)

	Vehicle	Simulator	Skills Taught	Experiment	Results
1954 (NTDC) SDC 71-16-11	SNJ	Cycloramic Link, mod.	approach & landing	trainer sub. for air time 12 hr. sylb.	61% fewer trials & 74% fewer errors for simul. group.
1957 (NTDC) (71-16-16)	SNJ	Cycloramic Link, photo-mockup, procedures train.	procedures	3 trainer groups compared to each other and flt gr.	all groups equal after 3 air trials.

Recent History

	Vehicle	Simulator	Skills Taught	Experiment	Results
1968 (HumRRO)	Army Helicopter	1-CA-1 mod. to quasi-rotary-wing configuration.	Instrument flight in rotary wing training. (U.S. Army Aviation School)	Total N=145. 3 groups: 0 hrs., 10 hr., and 20 hr. synthetic training (20 hr. gr. vs control). All groups received 25 hrs. flight training.	No significant difficulty between groups.
1968 (HumRRO)	Army Helicopter	"Whirlymite" captive helicopter	Rotary wing contact flight	Total N=132. Divided into 2 experimental groups and 2 control groups with no training or device. 0, 3 1/4, 7 1/4 hrs of practice.	(1) 10% attrition for flying deficiencies in exper. groups. 30% attrition for control groups. (2) 2 hrs. less flight training needed to solo for exper. groups. (3) flt. grades higher early in training.

	Vehicle	Simulator	Skills Taught	Experiment	Results
1966 (NTDC) NAS, Corpus hristi	Automobile	Aetna Drivotrainer	Automobile driving improvement	Comparison of untrained group (N=88) with group trained on simulator, also N=88.	Better test-driving performance with experimental (trainer) group than with control group
1966 (NTDC) cfficer Candidate school (USNOCS) Program	Surface ship	Device 1BZ2 Maneuvering Tactics Trainer	Surface Ship tactics	1BZ2 Exercise Series (BZEX) containing 14 problems were used for measurement	Criterion-referenced meas. sys. developed which could be applied to a transfer study with Device 2CA61.
1971 (NTDC) Naval Air Tech. tr., Glynco, Ga.)	Airborne ECM Systems	15E18 Tactical ECM Trainer	Operators are trained to locate and classify emitters, and to select proper countermeasures	Learning measured through performance improvement	(1) Trainees rapidly reached required performance levels due to prior operational equipment experience. (2) Not utilized to full capability. Recommended more effective use.
1971 (Univ. of Ill.) H.F. Bulletin Vol. 13 No. 2)	Piper Cherokee	AN-T-18 (Link "Blue Box") GAT-1	Flight course leading to private pilot certificate	52 students into four groups: (A) previous flt. trng. (B) A/C (C) AN-T-18 and (D) GAT-1	Gr. / Av.Flt. Hrs. to Crit. / Trnr Hrs. / Sav. Flt. Hrs. / Trans. Effec. Ratio A/C 45.5 AN-T-18 36.5 11.0 9.0 0.8 GAT-1 34.5 11.0 11.0 1.0
1969 (NTDC)	ASROC-equipped ships	X14A2 Surface Ship ASW Attack Trainer	ASW team trainer	Three conditions: A-No refresher trng (N=5) B-Full team refresher training (N=6) C-Key part team refresher trng (N=6)	Skills learned in ASROC trainer lost within 16 weeks at sea but regained quickly with refresher training.

Recent History (Cont'd)

	Vehicle	Simulator	Skills Taught	Experiment	Results
1971 NTDC)	S2E aircraft (4-place, twin engine, carrier-based ASW aircraft)	2F66A WST	Weapons system training. Both team and individual training for air antisubmarine warfare missions.	To demonstrate learning through measured performance improvement. Subjects: VS-41, San Diego N=13, VS-30, Key West, N=12. (Same subjects performed in different operator positions on different sessions.)	(1) #4 Oper. (Julie-Jezebel) showed substantial learning. #3 (MAD, ECM, radar & nav. computer) and TACCO showed minor improvement. (2) San Diego students gained more than Key West students. (Diff. resulting from location). (3) More frequently used as individual than team trainer. (When first used as team trainer, performance decreases, then improves) (4) Instructor evaluations of trainer (via questionnaire) - criticism of equip't. reliability and lack of realism of A/C simulation inputs. San Diego instructors rated device highly; Key West instructors did not.

Appendix 8-1

NPRDC has been given management responsibility for the development and delivery of both individual and team training packages for four new Navy aircraft systems (S-3A, P-3C, F-14 and SH-2). Each system requires the development of scorable training scenarios to be used with each system's operational system trainer, or equivalent.

The Tactical Exercise Simulator and Evaluator (TESE) is used to train Marine Corps officers in combat decision-making. The project, operational in 1976, seeks to define procedures for wargaming. The goal is to get both computer-based individual and team measures during amphibious warfare exercises, and to increase the number of trainees who can be processed.

The Tactical Warfare Analysis and Evaluation System (TWAES) is a computer assisted system to control tactical field training exercises. The system offers potential improvements in maneuver control and the simulation of indirect fire.

The combined Arms Tactical Training Simulator (CATTS) was initiated in FY 1973 and has the purpose of providing battalion commanders and their staffs with simulated combat situations operating from a ground command post. The simulator utilizes a Xerox Sigma 9 computer. The training objectives which CATTS is designed to meet are:

a. To identify the relationship that exists among various elements and with the enemy.

b. To identify alternative courses of action, appropriate formation, maneuvers and fire support application.

c. To communicate decisions to subordinates using fragmentary and tactical orders so that decisions can be effectively interpreted.

d. To manipulate and monitor the variety of tactical ratio networks available at the battalion level.

Appendix 8-2

The Army has underway a major endeavor for revitalizing unit training through the development of an Army Training and Evaluation Program (ARTEP) for each type of unit. The purpose of ARTEP is to:

a. Evaluate the ability of a battalion to serve as the nucleus of a combined arms task force performing specified missions under simulated combat conditions.

b. Provide a guide for training objectives by specifying minimum standards of performance for combat-critical missions and tasks.

c. Evaluate the efficiency and effectiveness of past training of all echelons of the battalion from crew/squad through battalion/task force.

d. Provide an assessment of future training needs.

ARTEP is written for Active Army and Reserve Component units undergoing training in a peacetime operational readiness environment. The emphasis is on fundamental, frequently performed missions and tasks. Unit proficiency is judged on the basis of mission performance rather than the extent to which elaborate or detailed procedures have been followed. Also characteristic of ARTEP is that concurrent, multi-echelon (as opposed to sequential) training and evaluation is encouraged and facilitated. This is appropriate given rates of personnel turnover and the other "squeezes" on training common to many Active and Reserve Component units in peacetime. However, the modular design of ARTEP permits the use of sequential approach, from crew/squad through platoon and company to battalion, if that system is appropriate.

Appendix 8-3

REALTRAIN, a simple, inexpensive method for providing realistic, motivating small-unit training in the maneuver arms, was developed on the basis of proven principles of effective instruction, stressing combat realism involving two-sided, free-play exercises. Designed to require a minimum of special equipment not normally found within a training unit, this simple, inexpensive method of small unit training, called the REALTRAIN method, has generated enthusiastic interest on the part of military commanders and enthusiastic participation by enlisted men in the field. REALTRAIN I, which has been implemented in infantry units world-side, provides training for the Infantry rifleman at the squad and fire team level. REALTRAIN II provides tactical training for tank crewmen; REALTRAIN III provides tactical training for anti-armor personnel. REALTRAIN II and III are currently being implemented world-wide by the Armor School.

The increased concern for improving unit training dictates a similar increased concern about methods for the reliable and valid measurement of unit proficiency. The objective of this research was to establish a method for deriving objective and valid criteria for assessing unit proficiency and, further, to provide a measurement framework for unit proficiency assessment. Initial efforts identified major problems and deficiencies inherent in current unit testing. Guidelines providing the foundation for later developmental efforts were established: 1) Evaluation criteria selected should be as objective and quantifiable as possible and should reflect actual performance on the battlefield; 2) unit assessment should be "product" rather than "process" oriented, emphasizing final products (mission objectives); and, 3) the assessment methodology should include prescribed standards of performance providing a pass-fail decision capability. A Unit Performance Assessment Model (UPAM) has been developed. This model includes consideration of a unit's achievements as well as the 'costs' incurred in attaining these achievements. Included in the model is a procedure for selecting meaningful tactical criteria upon which to assess performance.

UTRAIN is a research project on methods for enhancing the training capability of unit training personnel. To provide effective training, personnel in units must be familiar with techniques of performance-oriented instruction. The objective of this research project was the development and evaluation of a 10-hour introductory block of instruction on performance-oriented training for use in TRADOC schools and the development of recommendations for further instruction on performance-oriented training in specific subject matter areas in officer and NCO basic and advanced courses. The 10-hour block of instruction on performance-oriented training has been prepared and subjected to formative testing at both the Infantry and Armor Schools. After final (summative) evaluation at the Infantry School (which has proponency for Army-wide training instruction), the 10-hour block of instruction, with supporting video tapes, will be

"exported" to the other TRADOC schools. The project also resulted in recommendations for extending instruction on performance-oriented training to specific subject matter areas in officer and NCO basic and advanced courses.

The Corporate Battalion Simulation Game Design Project concentrated on the study of the interactions among battalion staff personnel and the development of an instructional game to provide battalion staffs realistic training for the accomplishment of their interacting functions in the planning of combat operations. This research was necessary because training at the battalion staff level is generally limited to command post exercises which are usually held only once a year and for the most part provide insufficient training in interactions among staff personnel in the performance of their duties. Initial efforts in this project consisted of research into battalion staff operations and the use of games in a military context. Current training in this area (e.g., the CPX) was also studied. On the basis of this review, the structure for a one-sided game was developed. The game and its scenario was developed and refined through tryout and review by gaming experts, CATB, and ARI Army military and research personnel, and potential users.

Appendix 8-4

Both ARI and USMAC provided information on the relationship between the R&D and user communities in the Army. According to ARI, CGTU training relates to research products used by operational units in the field, and it is critical that ARI maintain cognizance of the operational environment to insure an acceptable product. In this research area, three sources of the required information is available:

a. As CGTU training research is, of necessity, carried out in the field, researchers can observe the operational environment directly and translate these perceptions back into the direction of the research.

b. CGTU training research personnel work closely on a continuing basis with military personnel at CATB, at appropriate Army schools, in operational units (both in CONUS and USAREUR), and with the Deputy Chief of Staff for Training, TRADOC, to insure that the CGTU training research program is complementary with and responsive to Army initiatives to improve unit training.

c. ARI's Military Requirements and Product Utilization Office has as an explicit mission to insure the "implementability" of ARI research products. This office maintains cognizance of research efforts from their inception to their conclusion.

USMAC encourages frequent visits to the field by laboratory personnel. The establishment of PM-TRADE and TRADOC TRADER at Fort Benning, Georgia, is an attempt by the user and developer to effect a close working relationship. Periodic program reviews are scheduled to inform appropriate activities of the Program Status. During formal IPR's, the user and developer have equal status in determing the acceptability of all training device developments.

The Navy stated that there is close interaction between the R&D and user communities, but did not provide the Task Force with any elaboration or explanation of this statement. The Air Force did not respond to Task Force inquiries.

Appendix 8-5

7 March 1973

TRAINING IN THE BRITISH ARMY: A SURVEY OF PRACTICES THAT MAY APPLY TO THE U.S. ARMY IN A VOLUNTEER ENVIRONMENT

by Colonel John W. Seigle

INTRODUCTION

Although the United States has now achieved the objective of maintaining armed forces in a "zero draft" environment, it has not yet reached the point at which it has in being a full *system* for maintaining trained forces in this environment. This is particularly true of the United States Army. The largest of the armed services, it has also been the most dependent on the Selective Service System, the most subject to large increases and decreases in overall size and—of necessity—almost exclusively concerned during the past seven or eight years with the maintenance of a training base that could meet requirements for the war in South Vietnam.

With the end of that war and the achievement of a volunteer force at substantially lower manpower levels than were needed during the war, the Army has an opportunity to achieve greater job stability and to structure new programs of training to insure professional competence. Seizing this opportunity poses a formidable challenge, however, for we have little if any relevant, institutional memory on which to rely. The Army's present policies and practices are those which have evolved over three decades during which the manpower draft was literally the engine driving the train. Except for one brief period, 1946-1948, selective service has provided the bulk of Army manpower for as long as virtually anybody still on active duty can remember. Even those few still remaining who entered the Army prior to the initiation of the manpower draft (1939) have served for over thirty years in an armed force largely dependent on selective service.

Recognition of the fundamental change that the Army is undergoing has produced a sizeable flow of articles, special studies and staff actions on the conditions of service and living standards that ought to be (or can be) associated with a volunteer force. Without detracting from the necessity and the usefulness of this effort, it is still important to observe that it may well have focused on a secondary area.

Living conditions and benefits are important to the extent that they remove irritants, but they cannot do everything. *It is only through job performance that soldiers can achieve the sense of accomplishment that produces high morale. It is only by working together—by facing and surmounting challenges that have some meaning in the realm of military competence—that units can develop esprit de corps.*

If one accepts these propositions, it follows that the Army needs to concern itself with this world of work, not to the exclusion of living standards and benefits, but because it recognizes that it is jobs, not off-duty opportunities, that are the primary determinant of willingness to serve as a volunteer. In an Army not fighting a war, these jobs are what training is all about.

But with so many of our institutions and practices of military training being the product of many years of selective service, it is difficult to conceptualize an appropriate system for training in this new environment. That is why this article examines the major outlines of the system in use by another Army.

OVERVIEW OF BRITISH PRACTICES

Even the most casual reader will be aware of differences in tradition, recruitment and service that make it inappropriate to attempt to transfer directly to our Army all of the practices of the British Army. That is not what is suggested. Rather, we ought to study other armies—much as Emory Upton did almost a century ago—in order to discover concepts and ideas which might be applicable to our own situation.

Dissimilarities aside, it would be remarkable if we were not to discover useful parallels between our Army and our sister service in the United Kingdom. The British Army, like our own, has served democratically-controlled governments for many years. As Rudyard Kipling has reminded us, it has been the recipient of adulation "when the bands began to play," and the target of somewhat less enthusiasm when the needs for its services were less apparent. More to the point, it has existed for 12 years as a volunteer force, following a long period of selective service similar to our own. It has essentially completed the restructuring of a system to train this volunteer force.

This article restricts itself to a survey of the key points of the British Army's overall system for training that portion of an armed force which is most unlike trades and pro-

fessions in civil life—the combat arms. It emphasizes those aspects of NCO and officer training which most differ from practices in the U.S. Army and sketches the impact that this training in schools has on training conducted in units.

The British Army has three combat arms schools: The School of Infantry, Warminster; the Royal School of Artillery, Lark Hill; and the Royal Armoured Corps Centre (RACC), Bovington. Although the RACC technically contains a series of "schools," these are functionally identical to their counterpart "wings" at Warminster and Lark Hill—an anomaly that causes no concern and no apparent pressures for "standardization." The British Army consolidated its field and air defense artillery arms in the mid-1950s. Consequently, air defense artillery instruction is presented by a wing (or major subelement) of the Royal School of Artillery.

The commandant of each school is a brigadier who reports to a major general, director of the branch. The branch director, who has overall responsibility for the status of training, equipment and personnel management (but not promotions) in his arm, is thus in a position to exert direct influence on the school curricula and course offerings based on his equally direct access to the regiments of that arm and his perception of their needs.

Both the schools and branch directors are loosely controlled by the Director of Army Training (DAT) in the Ministry of Defence (Army). The DAT is responsible for the staff supervision of all Army training, from preentry to senior sabbatical and in units as well as training centers. Inherent in these responsibilities is the authority to make the Army schools—especially those with Army-wide missions, in this instance—responsive to the needs of units.

INDIVIDUAL TRAINING

Regimental Commander's Responsibilities

It is in the context of this responsive capability to make changes from the top in order to serve the needs of units that the primary responsibility to make the school-unit link work is placed squarely on one man—the regimental commander (battalion commander in U.S. terminology). Not only is he responsible for the status of his unit's training as a unit, he is also responsible for insuring the individual proficiency of his soldiers. In this regard, he is expected (and occasionally directed) to make certain that requisite numbers of his noncommissioned officers and warrant officers (comparable to senior NCOs in the U.S. Army) are school-trained in the entire range of duty positions represented in the unit.

The importance of the regimental commander is difficult to overstate, because it is the *continuous training of NCOs who are trained to be trainers* that is one of the keys to the British system. Within such a system, the regimental commander can be properly be held accountable for the individual proficiencies of the members of his command. Consequently, while he is provided a guide for the minimal number of school-trained physical training NCOs, for example, who should be in the regiment at any given time, he is also judged in part on the degree to which he "lays down wine" for his successor in the form of exceeding these minimums. Thus, while the schools provide trained specialists to the regiments of the Army, the regimental commander is expected to control the rate of flow of such trained NCOs in a manner that will be conducive to good individual training.

The System

The schools, for their part, undertake to do more with these selected NCOs than simply develop their competence to perform a given set of skills. They consciously and explicitly train them to be trainers. These NCOs and warrant officers come to the school of their arm to be trained to instruct in a specified skill. Then they return to their regiment to reoccupy their assigned TOE positions (squad leader, tank commander, etc.).

When a school-trained instructor's company is engaged in unit training in the field, he performs normal duties in his TOE position. When the unit training cycle moves to individual skill "continuation" or MOS training, the school-trained instructor is called upon, depending upon the specific level to which he has been certified by the school, either to instruct junior NCOs who will in turn train their own squad/crew members in that specialty or to train his own squad/crew in the specialty in which he has been specif-

ically qualified.

As an example, each Royal Armoured Corps NCO specializes in gunnery, communications, or driving and maintenance. When he is a junior NCO (corporal or sergeant) he goes to the Royal Armoured Corps Centre for a six- to eight-week course, during which he is trained to instruct in his specialty in his company environment. When he returns to his unit, he carries a set of lesson plans and simple training aids (or knowledge of how to make them) for the subject he normally will teach in his unit. He also returns with a certification (more or less formal) that he is licensed to instruct to a given level of proficiency. Some NCOs fail to receive the instructor certification and become limited in their advancement potential. After several years, the successful NCO returns to RACC for additional upgrading as an instructor. Infantry and artillery have a system not too different from that described above. The infantry system is less structured than the other two and the artillery is the most highly structured.

Although there are a few exceptions to the summary above, the predominant pattern is clear and clearly understood by all three combat arms schools. The function of each school is to train instructors who will, in turn, train the men in their units in specific skill areas. Thus, the combat arms schools help to make it possible for specially prepared NCOs to conduct individual training in units on a decentralized basis.

This conscious pattern of decentralization is reversed only when the subject matter is so technical or the equipment so complex that it does not pay to train trainers who then train others. Within the combat arms, these conditions will only be met for the highest level training of individuals in low density MOS. Thus, the schools are now attempting to train all of the most highly qualified signal personnel within regiments, rather than depend on a few school-trained instructors to train the others. This is, at present, the only exception to the pattern of centralized instructor training and decentralized individual training in units.

The same pattern is even found in a functional area common to all arms--physical training. Each regiment has one or more school-trained NCOs as physical training instructors. These members of the Royal Army Physical Training Corps train junior NCOs who, in turn, train the men under them. The instructors return periodically to the Physical Training Corps School for refresher and update training. The school is, in effect, guiding the physical training and unit sports program throughout the Army.

Reasons for Effectiveness

Three special conditions and practices permit this system of school-trained instructors to work effectively. *First,* since soldiers in the British Army tend to remain for relatively long periods of time in the regiment for which they have enlisted, the regimental commander has a reasonable expectation that the effort he takes to have NCOs trained as trainers will have a direct and beneficial effect within his regiment. In fact, only recently have transfers (from one battalion to another of a given parent regiment) been encouraged to permit better individual career development and to meet the needs of the service. Even today there are no transfers simply for the sake of a transfer.

Consequently, there is a high probability that the NCO trained as an instructor in tank gunnery, for example, will pay dividends to the unit that went without his services while he was undergoing this training. Even those trained to be artillery gunnery instructors in the year-long course at the Royal School of Artillery, most of whom will then serve as full-time instructors at Lark Hill or with one of the Royal Artillery training teams throughout the Army, are encouraged to return periodically to regimental duty. In this sense, the systems work to insure that NCO trainers do not become too removed from the realities of life in units.

Second, the schools have evolved methods by which to train the potential instructor in *how* to train soldiers in the professional area in which he is being schooled. The potential instructor prepares and presents, typically, about ten periods of instruction which are graded by different members of the school faculty. But beyond this traditional "methods of instruction" training he also receives tips on some effective ways to "get it across" to soldiers, plus simple lesson plans and training aids. The kit he carries when he returns to his unit is not just

in his head.

Third, the performance objectives of individual proficiency training are specified Army-wide–by level of proficiency–and known to unit commanders, the schools and instructors alike. This means that the school can certify (or decline to certify) an NCO to instruct in field artillery gunnery, for example, to a given skill level. The unit commander knows what it is that his soldiers must be trained to be able to do in order to be considered proficient; he also knows what they must be able to do if they are to be qualified at a higher level of proficiency–which affects both their pay and promotion. The school concerned prepares instructors to raise individual proficiency to the same levels. There is no vague talk of "familiarizing the soldier with..." or "developing competence in...." Everything is made concrete and specific. The schools that train instructors, the instructors themselves, unit commanders and interested soldiers all work from the same sheet of music. Standards do not simply determine who is most proficient on an unknown scale; they prescribe what must be done in order to become proficient.

UNIT TACTICAL TRAINING

Thus far we have examined a very explicit form of the school-unit link – the schools training NCO trainers to conduct individual training in units. A second form of school-unit link exists about which the British are less aware, even though it may well be an equally influential aspect of the school's role. The schools are consciously aware that they are attempting to train officers to be qualified to conduct the tactical training of units. The schools seem to be unaware of the widespread applicability of the model for the tactical training of units that they habitually export to the field.

A brief comparison may be helpful in understanding the importance of this model for training. Most officers in the U.S. Army, when asked whether their combat arms school teaches any model for training in units, would quickly reply that it does not. Similarly, British officers typically are unaware that the school of their arm is suggesting to them a way to conduct unit tactical training. Yet in both armies there is a distinct and almost universal tendency to emphasize a set of practices embodied in instruction at the school. Without either the schools or the officers who leave them being quite aware of it, there is an observable tendency for units to emulate the schools in their training practices. These training practices differ markedly between the U.S. and British Army. Hence, one may observe very different ways in which units typically attempt to train.

U.S. Army Model

The U.S. Army model (again, remembering that it is not consciously regarded by the schools as a model for use in *units*) has two aspects. In its most visible form, the school model has been accurately characterized in the Board for Dynamic Training's final report as creating a "platform-podium-pointer-poop" syndrome. That is, with the emphasis on classroom instruction by lecture or discussion, the faculty members tend naturally to place considerable weight on instructor techniques and careful lecture preparation. The soldiers who are exposed to this implicit model tend to carry it with them to units and to put it in practice there.

The second aspect of the U.S. model concerns the sequence of exercises by which a unit trains in a particular tactic. Habitually, the young officer organizing his company's training in the delay, for example, will recall the sequence of training presented to him at the branch basic course. He will present a formal class – instructor-centered, of course – perhaps conduct a demonstration, and then turn out the entire unit to try the tactic. Thus, the Benning (or Knox) model of "conference-demonstration-practical exercise," better suited for resident officer classes, becomes also the model way in which units are trained.

The schools are abetted in their unconscious success in disseminating an Army-wide model for training by FM 21-6, Techniques of Military Instruction. Considered by some to be the trainer's bible, FM 21-6 perpetuates the "platform-podium-pointer-poop" syndrome while omitting completely any reference to tactical training.

British Army Model

As their American counterparts carry a training model out of the service schools, so do the British officers unconsciously assimilate an approach to training. The British

model for unit tactical training is founded upon the core concept that leaders (down to squad leaders) must be thoroughly trained in their responsibilities in a particular tactic before the entire unit is turned out to try the tactic. Leader and unit training is facilitated by a bag of training methods available to every trainer. He selects those which are appropriate and arranges them in a sequence to accomplish his purpose.

This sequence may begin with a lecture and discussion to explain the tactical doctrine and its application on the ground. But before jumping directly to a full-blown practical exercise (or FTX), it proceeds through several intermediate steps – each of which places the appropriate troop leader in an increasingly realistic training situation without involving all the soldiers of his company, platoon or squad. This progression moves from indoor "model exercises" (common also in many U.S. Army schools) to outdoor "Tactical Exercises Without Troops" (TEWTs) – which are relatively uncommon, if not unknown, in the U.S. Army. It may include sandtable or cloth model exercises.

Perhaps the most widely used exercise is the TEWT, whose purpose is simply to "teach the detailed application of tactical principles to the ground before the stage of an exercise with troops is reached." It is a "terrain walk" with a specific scenario designed to train selected leaders in a specific tactical application of doctrine. The leader receiving the training – who may be a squad leader or a company commander – is given a mission, a picture of what the enemy is doing, and then asked to formulate his own actions, to organize the ground he will defend or to select the ground across which he will attack, and to react to a variety of realistic "incidents," all of which occur on a battleground without troops on either side.

Following the TEWT as a training vehicle, the tactical instruction may move – again, toward increasing realism but using primarily leaders – to "skeleton exercises" in one or more of a variety of forms. These include orders, group exercises, reduced distance or full-scale rehearsals and command post exercises. Not every training sequence will employ every one of these techniques. The key is that only the *leaders* will train to the extent feasible in increasingly realistic situations. The full unit practices the tactical principle only as the *last* of several steps in sequential training.

This is the model which British Army officers carry from their schools to their units. It forms the basis of their tactical training, first at Sandhurst (which all prospective officers now attend) and then at the combat arms schools. Its application is so ingrained in practice that most British officers are literally unaware that they are applying a school model to training in units. Indeed, when asked about it, they are likely to inquire politely if there is even another possible way to go about the job of tactical training.

IMPACT OF SCHOOL-TRAINED TRAINERS

The proof of this scheme for training trainers is not, of course, in its theoretical elegance; it is in its application in units. Remembering that the British Army has a means by which to make the schools responsive to the entire gamut of unit needs (the directors of the branches and DAT) and that it places the requirement firmly on one key individual (the regimental commander) to insure that the number and distribution of trained trainers is adequate, what then? How does this process contribute to good training in units?

Individual Training in Units

The principal impact of NCO training occurs in that area the British call variously "internal training" or "continuation training." It is roughly equivalent to "individual proficiency training conducted in units" in American usage. And it occupies a very substantial percentage – roughly half – of the total training time available to the unit.

Whatever kind of such training is conducted – from map reading to marksmanship – the school-trained instructors are called upon to help organize and conduct the training. This may mean that an NCO trains all the soldiers of a company-size unit in some specific skill, but it will more likely mean that the most skilled instructors train the junior NCOs who, in turn, train the soldiers in their squads and crews. The practice of training NCOs to be trainers is not limited to the school courses; it extends to training within units. Not only is this an effective use of the chain of command; it also encourages decentralization of training – but only to the

extent it can be effectively decentralized, as already described above.

One special category of individual proficiency training illustrates this technique. The British call it "cadres" (and pronounce it "carders," as if to strike back at the recent actions of the French Academy). Unlike its closest U.S. counterpart, "cadre training," it does not apply only to soldiers *already* in key positions. It is designed expressly to train selected soldiers *for* key positions.

"Cadres" are specially organized periods of individual training, conducted by unit personnel. They may vary in length from a portion of a day to, as a practical limit, about two weeks. The junior NCOs in a given regiment, for example, might attend one of the longer "cadres" to receive training designed to prepare them to be squad leaders. The school- trained instructors of the regiment will conduct training in those areas in which they are specially qualified. The regimental sergeant major will be sure to lead the training on appearance and military courtesy, and the regimental commander will play an active role.

Shorter "cadres" will be organized periodically for less general purposes. A tank or cavalry regiment, for example, would use its most highly-trained gunnery instructors to upgrade the gunnery training capability (not just the understanding) of its tank commanders. Similar training might be extended to training designed expressly for those junior NCOs whose previous specialty training has been in communications or in driving and maintenance. Thus, "cadres" can contribute to cross-training within the unit.

The interrelations apparent in this method of training reveal something of the fully-developed system which exists:

– Individual proficiency training, both for competence in job and as preparation for higher responsibility, is conducted on a decentralized basis within tactical units. The general rule is that training is given by the lowest organizational level with the competence to plan and conduct it effectively. This might be company level for rifle marksmanship but brigade level for radioteletype operators.

– The key trainers in this system are NCOs who occupy normal TOE positions within the unit *and* have also been school-trained and certified to train others in one or more specialties. In effect, a specially tailored organization from within the unit's own resources is called into being for individual proficiency training.

– The British Army seeks to develop individual tactical and technical competence by training *within* units to the maximum extent possible. School courses are not intended merely to train soldiers in knowledge and skills; they are designed to train them to train *others* in specified functions.

– The process by which the schools train individuals to be individual training trainers within units establishes a direct school-to-unit linkage. This is reinforced by organizational arrangements that make the schools responsive to unit needs.

Tactical Training

The school impact on unit tactical training is equally significant. Implicitly, the schools have trained the combat arms officer to be a unit tactical trainer. The officer internalizes a training model grounded in the enhancement of leader professionalism and the parsimonious use of soldier time. A rifle company does not turn out to try a night attack until the leaders know their roles thoroughly. Hence, individual soldiers need not become bored by repeating a particular tactic until their squad leader or platoon leader learns his job.

CONCLUSION

As already noted, this comprehensive and flexible system of training trainers may not be susceptible to wholesale importation into the U.S. Army. Differences in the relative stability of enlisted assignments to a given unit, and differences in the typical military experience of company level commanders, suggest that there will be inevitable and proper differences in the way these two armies can train most effectively. But the British Army system can and should serve as a stimulus to our Army to develop its own system of training which suits this crucial function.

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